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ELECTRICAL REVIEW

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ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E.
General Editor: J. H. COSENS
Technical Editor: P. W. TUCKER, M.I.E.E.

8 APRIL 1955

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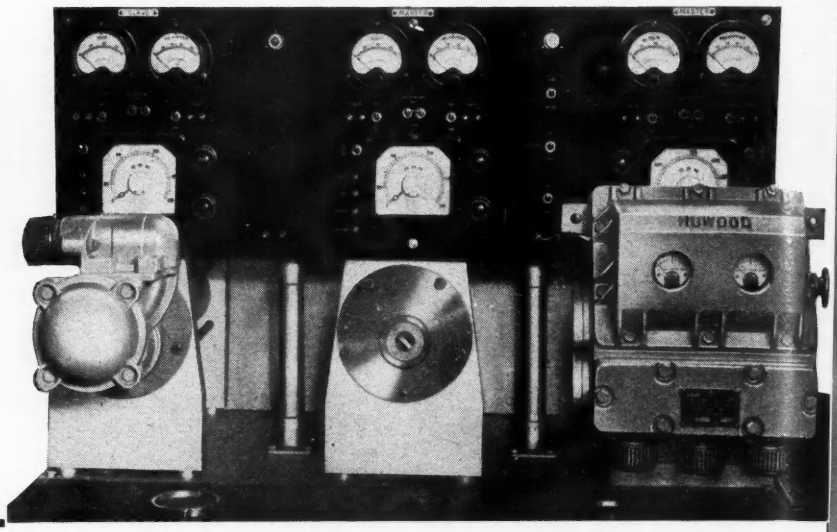
Spearhead to the Coal Drive



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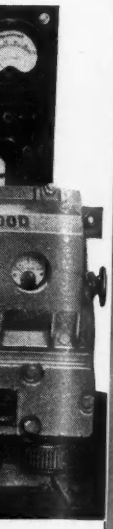


ELECTRICAL REVIEW

8 April 1955 Vol. 156 No. 14 Established 1872

Next Stage in Generation

CASTLE DONINGTON power station, due for commissioning next year, with its 100 MW sets throughout and boiler steam conditions of 1,600 lb/sq in and 1,060 deg F, foreshadows what seems destined to become general practice within the next few years. Thus no less than two-thirds of the 1,880 MW covered by the programme of the Central Electricity Authority for 1959 will be concentrated in ten generating sets ranging from 100 to 200 MW each—the first annual list in which units of 60 MW or under with less advanced steam conditions have not predominated. When completed to its full complement of 600 MW, Castle Donington will have the largest capacity of any station in Europe, but it will soon be outstripped by another station on the Trent of 1,000 MW in five 200 MW boiler-turbine units, the first of which is now on order as reported by us on 4th March.

Main features of Castle Donington, taken from a paper presented by Mr. J. T. Edwards before the Society of Engineers, are given in this issue. The station will use low grade fuel from the East Midlands coalfields now under development. The adoption of the one-boiler one-turbine unit arrangement without any steam cross-connections argues confidence in ability to cope with any bonded deposits on the high temperature boiler surfaces due to sodium and potassium compounds found in this coal, which appears to have an unusually high ash content. Coal storage for an annual consumption of 1·5 million tons takes two-thirds of the site area, compared with less than one-twelfth required for the buildings. The chimneys are taller by one-third than those hitherto usual for modern stations, presumably to be free from all suspicion of offence.

Inadequacy of summer supplies of river water for condensing has necessitated the provision of supplementary cooling towers, but some saving is made on the justifiable assumption that at least one set will then be out of commission for maintenance—evidence incidentally that a 100 per cent plant load factor, if attainable, would not necessarily be economic. Another feature of the layout, which looks forward to a more distant transmission of power in the future, is that three of the alternators are to be switched at 275 kV instead of at 132 kV. The architectural features appear to be innocent of the cathedral effect of some pre-war buildings, and seem likely to present a pleasing, well-proportioned functional appearance. The capital cost of Castle Donington has been estimated at £35 million. There is no question of such stations being superseded by nuclear power stations, which within the useful lifetime of plant projected in present programmes will be fully occupied in coping with yearly additions to the electrical demand of the country.

ECONOMIC OUTLOOK

Once again the Government's annual Economic Survey emphasizes the country's dependence on an expanding export trade. There is plenty of evidence that we are at present enjoying prosperous conditions at home; a useful index is the rise in electricity consumption which invariably accompanies a higher standard of living. Unfortunately the increase in purchasing power, if not accompanied by higher productivity, would tend to affect exports and this in turn would eventually lead to a lower standard of living. As the Survey shows, the main objective of economic policy is to ensure that, while the level of purchasing power is not so high as to interfere with the growth of exports or to attract a larger volume of imports than the nation can afford, adequate incentives are provided for long-term expansion. The Survey describes the present outlook for world trade as " reasonably favourable " and says that there are opportunities abroad for manufacturers to sell the goods they produce.

HYDRAULIC TRANSPORT

Several complex problems remain to be solved before the transport of solids in liquid suspension through pipes becomes wholly satisfactory; chiefly in regard to maintenance and power costs. The subject does not readily lend itself to theoretical treatment and extended and varied experience is still lacking. Data have now been correlated over a wide range in a paper presented before the Institution of Mechanical Engineers by Mr. R. C. Worster and Dr. D. F. Denny which is based upon investigations by the British Hydromechanics Research Association. Its special electrical significance relates to the conveyance of slurry from collieries to power stations. The delivery of a million tons yearly of tailings through $5\frac{1}{2}$ miles of pipe line with the aid of five 400 h.p. pumps was the chief difficulty found in operating the Emile Hucket power station, near Carling in France, particulars of which were given by Professor R. Gibrat and Mr. F. Chenin to the Institution of Electrical Engineers in February, 1954.

GRID CONTROL AND DIVISIONAL AREAS

Further thoughts about the inauguration of the new South of Scotland Electricity Board on 1st April have brought to mind a picture of the past which is to some extent revived. We refer to the pre-vesting day grid control areas. In the first of the National Supply Survey articles, following nationalization of the electricity supply industry (*Electrical Review,* 3rd June, 1949), we published a map showing the then new British Electricity Authority Divisions in relation to the former Central Electricity Board grid control areas. The map showed how these areas were, with a few exceptions, split so that there were generally two new B.E.A. Divisions to one of the former control areas. In the No. 6 National Supply Survey article (*Electrical Review,* 7th October, 1949) it was shown that the new South West Scotland and South East Scotland areas combined corresponded to the former Central and South Scotland C.E.B. areas, i.e., the Glasgow control area. Now the amalgamation of the South West Scotland and South East Scotland areas under the new South of Scotland Electricity Board once again brings approximate coincidence of the new supply area with the two former South Scotland Areas and Divisions. Similarly, some months ago the amalgamation of the Merseyside and North Wales and the North Western Divisions brought about a state where the new enlarged area became almost coincident with the former Manchester grid control area. We do not suggest that there is any special significance in the similarities between these more recently created areas and the old grid control areas, but it crosses our mind that at least from the organization point of view the new arrangement might lead to some simplicity because we have felt all along that the existence of system operation liaison engineers in those cases where Divisions were broken away from the original control areas pointed to a little complication.

UNDERGROUND HAULAGE

Continuing our series of articles on " Electricity in Coal Mining," Mr. T. E. Green shows in this issue that the biggest development for underground haulage is likely to be the introduction of the electric locomotive. This development is largely confined to the battery locomotive because of the prohibition of the trolley locomotive in the forward areas. The main problem seems to be that of standardizing to some extent the underground tracks, the gauges of which, when the industry was nationalized, varied from 1ft 6in to 3ft 6in. Mr. Green shows the magnitude of the task when he says it is not merely a matter of relaying tracks; the cost of car and machinery replacement sometimes amounts to ten or twenty times the cost of the complete haulage system. We feel that time should bring about ways and means of introducing the trolley locomotive into forward areas. But in any case there is plenty of leeway to be made up by the trolley locomotive in the rear areas.

NETWORK REINFORCEMENT

In the thirties, when there was a sustained effort to boost the sales of electricity in the domestic field and particularly space heating, it was questioned whether the existing supply networks in some towns were adequate to meet the possible demand arising from the success of this domestic campaign. Since that time many techniques have been developed for reinforcing supply networks—ring mains, tiebars, and so on—whereby the capacities of networks have certainly been increased. These techniques have so far met the requirements of load growth pretty well, but we feel that the doubts of twenty years ago are probably still more justified now. Wartime and post-war restrictions retarded the development of space heating, i.e. intermittent heating rather than base heating, so that the demand for heating resulting from a properly conducted sales campaign might be quite colossal. In some areas it is proving difficult enough to meet the normal growth of demand; any acceleration of expansion might put the Boards into a quandary. Much greater expenditure upon the reinforcement of distribution systems is becoming imperative.

ELECTRICITY IN COAL MINING

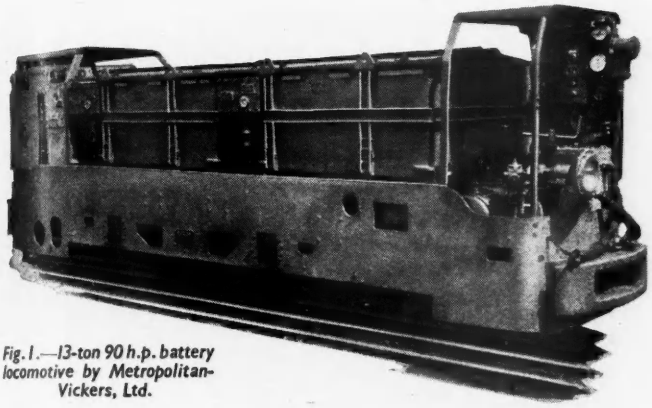


Fig. 1.—13-ton 90 h.p. battery locomotive by Metropolitan-Vickers, Ltd.

3.—Electric Locomotive Haulage Underground

By T. E. GREEN, M.I.Mech.E., A.M.I.E.E.
(Traction Engineer, National Coal Board)

As in other fields, the use of electric locomotives for haulage is steadily increasing in British coal mines. In the majority of cases this takes the form of electric battery locomotives which have not only grown greatly in numbers, but also in power and weight. Much work is being done on a wide variety of design problems, and it is reasonable to expect that future models will show marked improvements over those now in use.

The use of battery locomotives for underground haulage presents many difficulties. As with practically all electrical equipment in safety lamp mines, the motors and control gear must be of the certified flameproof type. Lead acid batteries have invariably been used in the past and since the process of charge and discharge results in the emission of hydrogen, a flameproof enclosure is not considered practicable. The basis of safe operation is adequate dilution of the hydrogen by dispersion into the mine air, ensured by the provision of ventilation apertures of a specified size in the battery container. The general efficacy of these various measures is attested by the very small number of serious mishaps with this type of locomotive. There have been cases of controller burn-outs, cell contacts shorted and occasional failures of some of the auxiliary equipment, but for over 30 years battery locomotives have given good service in the mines.

The sizes in use range from about 2 tons 25 h.p. to 13 tons 90 h.p. During the last four or five years a considerable number of 13-ton locomotives have been built, the general appearance of one of these being shown in Fig. 1. At the present stage of development this size is adequate for all except the most severe main haulage duties in the mines. Locomotives are usually built for one of the four recommended gauges, viz. 2ft, 2ft 6in, 3ft, or 3ft 6in, although it is occasionally necessary to buy new locomotives for mines where some other gauge is still used. This problem of track gauge size is worth a few minutes' examination. The N.C.B. is as keenly aware as any manufacturer of the need to restrict the number of gauge sizes to one or two agreed standards, but the problem is vast and complicated. When the mines were nationalized at the end of 1946 a survey was made of the gauges in use. It was found that these varied by increments of 0·25in from 1ft 6in to 3ft 6in; scattered over the whole country and over more than 1,500 mines. Further, the change is rarely an easy one to make. It is not just a matter of relaying track to a new gauge; mine cars have to be replaced and a vast quantity of associated machinery, both underground and on the surface, changed. The consequent cost of what appears to be a simple alteration will often amount to 10 or 20 times that of the haulage system itself and is a complete explanation of the apparent slowness of introducing what all agree is a desirable change. Nevertheless, it is one that is steadily proceeding and it is rare for a new haulage scheme of any magnitude to be other than one of the four recommended standards.

Much thought has been given during recent years to the question of battery capacity. Lead-acid batteries are both expensive and comparatively short-lived, being guaranteed for four years or 1,250 cycles, whichever is the shorter, and any improvement in their life or performance would be of value. Unfortunately their time-capacity discharge characteristic (shown in Fig. 2) is not very suitable for a mine duty which usually necessitates wide variations in discharge rates. It will be noted from the curve that heavy current discharges greatly reduce the available capacity, and in practice this has proved to be one of the most severely limiting features of battery locomotives. A constant problem is that of obtaining a reasonably accurate indication of the state of charge. If this were known with greater precision than is usually the case it might well extend the use of the battery type of locomotive. This appears to be one of those comparatively minor points which badly need fresh consideration. The mechanical

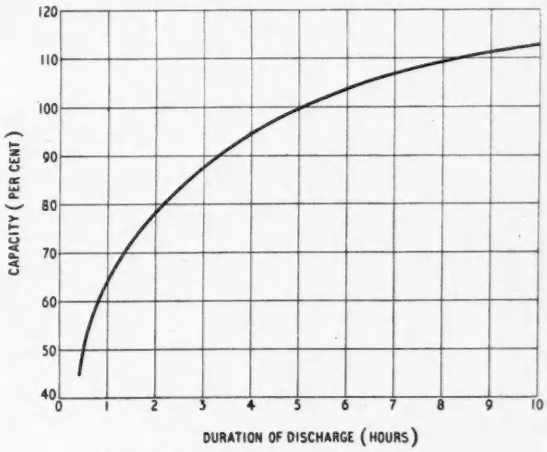


Fig. 2.—Time-capacity curve of lead-acid battery

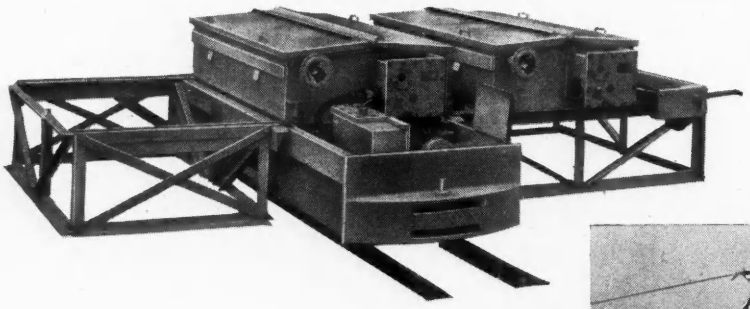
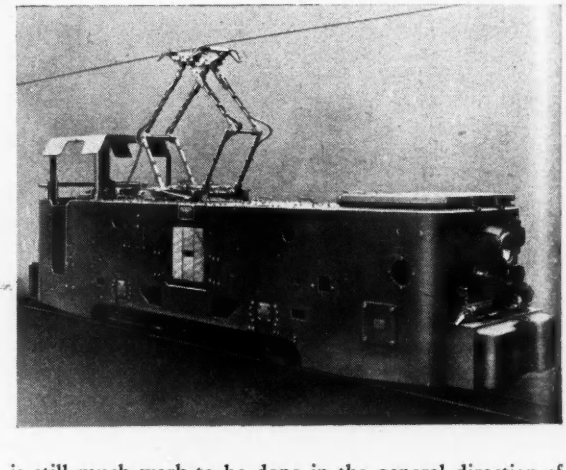


Fig. 3 (left).—Battery changing equipment

Fig. 4 (below).—8-ton 62 h.p. electric pantograph locomotive at Sandhole Colliery



problem of changing batteries, simple though it appears to be, is not capable of easy solution in a coal mine. On the biggest locomotives the battery may weigh up to four tons and is of considerable bulk. Space is often restricted and, particularly in some of the deeper mines, the roads tend to move, distorting and throwing out of alignment the tracks and other equipment which might be installed for the purpose. The Board's engineers are giving much thought to this troublesome auxiliary problem. A form of equipment which has proved useful for the smaller and lighter sizes of battery is shown in Fig. 3. A freshly charged battery stands on one of the frames and the locomotive with its discharged battery is placed in the centre. The two batteries are linked together and by means of the simple mechanism shown it is possible to roll the discharged unit on to the empty stand and the charged battery on to the locomotive in one operation. For the heavier batteries the rack mechanism may be driven by a small motor. There is still much to be said in favour of lifting the batteries from the locomotive chassis to the charging stand by means of a simple block and tackle.

The battery must also be adequately protected from any possibility of sparks due to the opening of an electrical circuit by means of isolating switches and fuses, and whilst there is no difficulty in designing a suitable circuit, the problem of accommodating the equipment together with the necessary plugs and sockets is a very real one. The amount of space occupied is well illustrated in the photograph in Fig. 1, and it must also be remembered that it is space which should be utilized by battery cells.

Thus it will be clear that whilst the basic type is well established as a suitable haulage unit in the mines, there is still much work to be done in the general direction of more efficient design and disposition of equipment.

There are as yet only four trolley locomotives at work in British safety lamp coal mines, all of them operating the Board's first installation of this type at Sandhole Colliery near Manchester. " Trolley locomotive " is something of a misnomer as will be seen from the photograph in Fig. 4, since the trolley pole type of collector is not permitted. The conditions governing all types of haulage in a mine are understandably strict, those of a trolley locomotive installation particularly so. The collection of current from an open wire, which is unavoidably accompanied by some sparking, however effectively this may be limited, is a somewhat startling operation when one reflects on the disastrous explosions which have taken place in mines in the past. But it is, of course, the case that the conditions of operation are such that this kind of possibility, as far

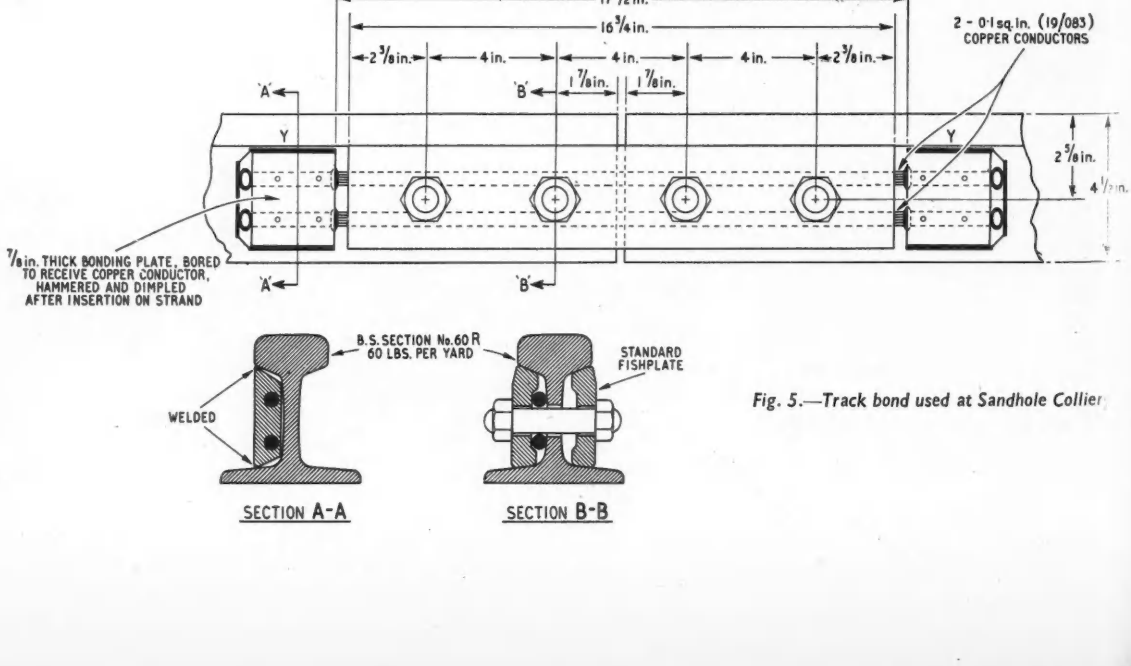


Fig. 5.—Track bond used at Sandhole Collier

as it is humanly possible, is completely excluded. Actually, this is one of the simpler problems associated with such an installation. One part of a coal mine which is almost immune from this kind of danger is the road carrying the fresh air into the workings, and by the simple expedient of limiting the installation to this "intake" road and stipulating that it shall not be carried nearer than 300 yd to a working face, safety is practically assured.

There are however, a number of interesting technical problems which might well be noted here. The floor, sides and roof of a mine road are always tending to move, however slightly, and in consequence the trolley wire and locomotive pantograph must have great flexibility. This has been very satisfactorily obtained by use of a simple cross span suspension and an excellent double pan pantograph which can be seen in Fig. 4. The locomotive itself is simple enough in its essentials; it is robust and compact and equipped in the main with well-proven traction motors and control gear. The motors are force ventilated and transmit their power to the axles through single reduction spur gears. The locomotive weighs 8 tons and has a continuous rating of 52 h.p., or a one hour rating of 62 h.p.

The present regulations restrict the voltage to 250; only a d.c. system is permissible. The consequence is, of course, relatively high currents and heavy (and expensive) copper. A further safety measure which must be observed is a minimum of 6ft 6in between the top of the running rails and the trolley wire, and 1ft from the wire to the roof or sides of the road. The track return system was chosen, mainly because of the formidable difficulties associated with positive and negative wires over double tracks in the restricted space of a mine road. The rails have to be effectively jointed and the special bond shown in Fig. 5 was designed. It will be noted that heavy double flexibles are accommodated between the fishplate and the rail web, an arrangement dictated by a specific regulation which states the bond shall be protected against mechanical damage from a derailed train.

Although locomotives in a mine work at low speeds, the restricted roads where men are frequently moving make them a very different proposition from those operating on the surface; and power to stop a train quickly and safely is imperative. Limitation of speeds and loads is one part of the answer, effective braking power the other. These comparatively small locomotives are equipped with air brakes and under the worst conditions of speed, grade and loading can always stop well within the field of vision of the locomotive headlights. The field of application for the electric pantograph locomotive is not likely to prove extensive in this country though there are some mines where its full capacity might be realized. It brings its own set of difficulties, and as with all other mining developments, due heed must be paid to these. Certainly, at this early stage of development in Great Britain stable roads of adequate size, with good conditions of ventilation, should be regarded as essential.

Much work has been done on the economics of underground haulage, principally with the aim of providing some guidance for future schemes. Every step has emphasized the complexity of the issues, due largely to the individual character of each mine, so that even now it is practically impossible to formulate any rule of general validity. These investigations will continue.

Electric Light Fittings

Association's Annual Luncheon and Report

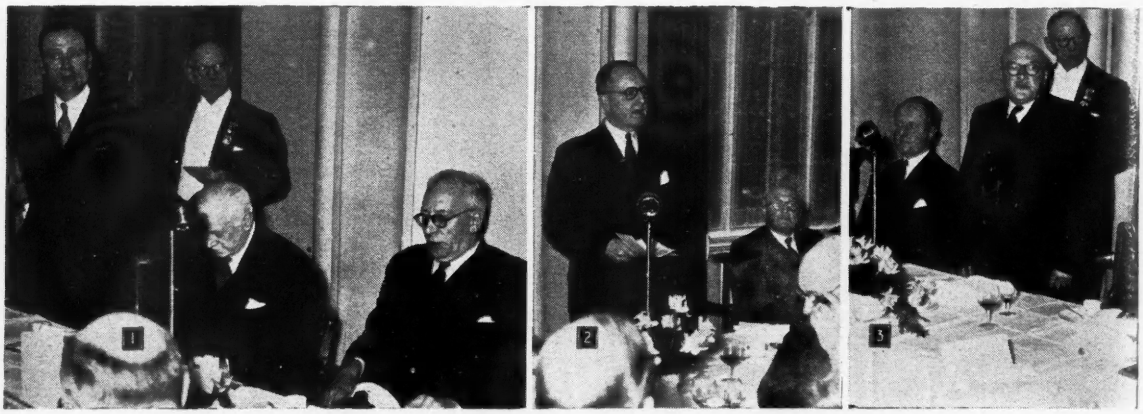
THE annual luncheon of the Electric Light Fittings Association was held last week at the Piccadilly Hotel, London. The first toast, of the guests, was proposed by Mr. C. J. W. Scott who referred to the various associations in the electrical industry and said that the many groups of initials were a reminder of the complete structure which had been evolved to carry on the industry. He referred particularly to the Association's close co-operation with such bodies as the I.E.S., the A.P.L.E., the B.S.I. and the E.F.T.C. It had no bones of contention with any of them.

Mr. E. C. Lennox, who responded, said that the Illuminating Engineering Society provided a common ground for all interested in lighting. The Society had as its aim the public appreciation of good lighting and in this it needed the assistance of the members of E.L.F.A. to ensure that the maximum value was obtained in the use of abundant lighting flux now provided so cheaply by the efforts of the lamp manufacturer and the electricity supply industry. He referred to the wastage by inefficient street lighting, poor lighting in the home, shops, factories and so on. So many lighting installations were designed and installed by people who had no skill other than some supposed natural instinct.

No increase of our national products would be carried out without considerable increase in artificial lighting provided in factories, mines, shipyards and offices. It was vital that we should have the benefit of the most efficient lighting fittings. Every encouragement should be given to ensure the training of a sufficient number of engineers in matters of illuminating engineering. We had not yet reached the stage where an engineer could obtain a technical degree in illuminating engineering, nor was there available a diploma in illuminating engineering which could be the aim of young engineering students. A diploma or degree to encourage the art of illuminating engineering would in due time ensure the proper use of the fittings which E.L.F.A. members were making.

General Sir William Morgan, who proposed the toast of the Association, first reviewed the general framework into which every business in the country had to fit and spoke of the need for peace and stability. He said that the products of the Association were endless and still growing. After referring to the bad street lighting in many towns and the demand for street lighting in less enlightened countries, he mentioned the important part that indoor lighting played in our lives, in the home, the office and the factory and said that the Association had an important part to play in this respect.

Mr. Hughes, responding, paid tribute to the men who had done a great deal of voluntary work on behalf of the Association, and particularly mentioned the chairmen of the various sections. Street lighting had received more than its measure of criticism in the Press, and much of this criticism was ill-informed. It was the Association's



1. Mr. C. J. W. Scott proposes the toast of the guests. On his left are General Sir William Morgan and Mr. C. Hughes (president)
2. Mr. E. C. Lennox replies on behalf of the guests. 3. Mr. F. W. Norris responds to the toast to the past-presidents

object to promote high standards of quality and design in the industry, and it was essential that E.L.M.A. products should be housed in properly designed lighting equipment. This country had a world wide reputation for decorative lighting fittings. Many problems had been overcome during the year, but one which remained to be overcome was the closer collaboration with manufacturers of control gear for fittings.

Mr. R. A. Bone proposed the toast of the past-presidents and paid tribute to the work of Messrs. J. N. Stephens, A. E. Iliffe, A. J. Burbidge, F. W. Winstanley, K. Scott Adie and F. W. Norris.

Replying on behalf of the past-presidents Mr. Norris spoke of the growth of the Association to its present importance and expressed the wish that the spirit of good will which existed among its members would be intensified.

ANNUAL MEETING

In his report for the past year Mr. Cecil Hughes (president) says that some sections of the electrical industry have been enjoying in the last few months what might be called a " trade boom," and although this may not be the case with the electric light fittings industry, the latter has benefited considerably, if indirectly, from the industrial confidence and stability that at present exists.

The new building programme continues to increase business annually, and freedom from unreasonable restrictions with great abundance of the essential raw materials are both welcome. The record achievements in house building at home hold every promise of good years ahead for the domestic fittings makers while for industrial, commercial and street lighting, heavy demands continue for the best and most efficient lighting equipment. Everything indicates also that export trade in lighting fittings will continue to flourish in spite of severe competition which is experienced from foreign fittings manufacturers. The industry as a whole remains highly competitive within itself, a condition which the Association welcomes. Mr. Hughes refers to the Association's active part in the work and deliberations of the Electrical Fair Trading Council.

Referring to trading policy, Mr. Hughes says that problems resulting from divergent policies of the building and electrical trades in relation to the treatment of builders with or without electrical departments, and the effect of p.c. sums and provisional sums in tenders under R.I.B.A. Standing Conditions of Contract, are being studied at length with the R.I.B.A. It is hoped that a further report on this subject will be made later.

Regular consultations have continued between E.L.F.A. and its kindred bodies in the electrical industry, for assisting and guiding all members.

Demands for new street lighting again expanded during the year and progress in research, design and manufacture has been considerable. In the industrial fittings section, following protracted negotiations with the E.W.F. the latter has decided that it no longer wishes to continue the policy of " exclusivity," an important condition of the E.L.F.A./E.D.L.A.C. Industrial Agreement " FGW " with wholesalers. The Association has therefore decided to terminate all agreements with wholesalers as from 31st March and notice of such termination has been given to all concerned. The economic considerations involved mean that the whole of the Section's trading arrangements with wholesalers must be drastically revised. In due course the revised trading code will be communicated to the wholesalers on the E.L.F.A. approved register.

The increasing importance of departmental and large multiple furnishing stores as large retailers of domestic lighting fittings is worthy of note, as are also the changing fashions and growing trends in decorative fittings generally. Traditional designs seem to be making way, to some extent, for modernistic styles.

E.C.A. Conference

THE annual conference of the Electrical Contractors' Association and Allied Associations will be held at Margate on 5th, 6th and 7th June. The provisional programme is as follows:—

On Sunday, 5th June, delegates will register at the Grand Hotel and in the evening there will be a concert. On Monday, 6th June, there will be a civic welcome at the Winter Gardens and reply by the president. This will be followed by a paper on " Hire Purchase," and a discussion. In the afternoon a garden party has been arranged at the Connaught Park, Dover; there will be no evening function. Tuesday's proceedings will open with the annual general meeting at the Winter Gardens during which members will be able to raise points for discussion. In the afternoon there will be a paper on " Sales Promotion," followed by a discussion and the installation of the new president who will give a short address. The conference will conclude in the evening with a joint reception by the Mayor of Margate and the president at the Winter Gardens.

Short Circuit MVA

Measurement on a Distribution Transformer M.V. Network

By D. C. MURCH, A.M.I.E.E.

THE short circuit MVA of a network is easily calculated from the impedance of the network from the supply source to the point under consideration. What is difficult however, is the determination of this impedance. The impedance of a network from the supply source to the secondary terminals of the distribution transformer can fairly easily be calculated, but it is the interconnection of the medium voltage network which makes the problem almost impossible to solve.

The full scale measurement of a short circuit applied to the network at the point under consideration is not in general a practical proposition, because of the difficulties of measurement and the interruption of supplies to consumers. The impedance of a network can be measured without affecting the supply to consumers and with relatively simple equipment, by the simple application of Thevenin's Theorem.

Consider a network fed through a bulk supply transformer T and network transformers T_1, T_2, etc., to T_N, as Fig. 1. If T_1 is switched off on the m.v. side then a voltage Vab will appear across the contacts of the break due to load currents. Now by Thevenin's Theorem the current that will flow when the circuit is closed is given by $I_{T_1} = \frac{Vab}{Zab}$ where Zab is the impedance of the network as viewed from the terminals a and b. Conversely Zab $= \frac{Vab}{I_{T_1}}$ where Vab and I_{T_1} are easily measured. Zab is Z_{T_1} in series with Zcb. Zcx with the break closed is Zcb in parallel with Z_{T_1}. Providing Z_{T_1} is known then Zcx can be calculated:—

$$Zcx = \frac{Zcb \times Z_{T_1}}{Zcb + Z_{T_1}} = \frac{(Zab - Z_{T_1})\, Z_{T_1}}{Zab}$$

If the impedance from the supply to the secondary terminals of transformer T is known to be Z_T, then the total short circuit MVA $= \frac{V^2}{Zcx + Z_T}$.

All these quantities must be treated as vector quantities and Vab and I_{T_1} must be measured as such. The vector position of Vab can be ascertained in relation to Van by measuring Van, Vab and Vbn then constructing the triangle as in Fig. 2. The vector position of I_{T_1} can be measured in relation to Van either by a power factor meter or by measuring the voltage Vxn with the break closed. In this case a new triangle of voltages can be constructed

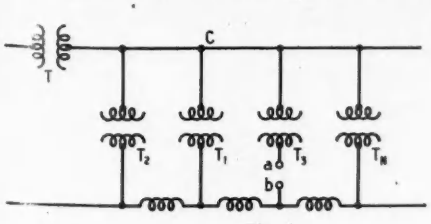


Fig. 1

of Vcn, Vxn and Vcx, the latter being calculated from I_{T_1} and the known impedance Z_{T_1} where Vcn is the same as Van in the previous triangle (see Fig. 3). The resistance and reactance of T_1 is known and Vcx can be divided into two right-angle components to represent the appropriate voltage drops, with the current vector I_{T_1} drawn in at right angles to the reactance drop. The above formulæ can be used to calculate the MVA.

The working can be further simplified by studying Fig. 3, where Vab can be considered as the e.m.f. for circulating a current I_{T_1} around the circuit of T_1, and the network c to b. Now the voltage drop Vcx is caused by this current and therefore a vector drawn between x and b must represent the voltage drop in the network c to b. Since the vector position of the current is known this voltage drop can be divided into two right-angle components, one in phase and the other in quadrature with the current. The values of Rcb and Xcb can then be

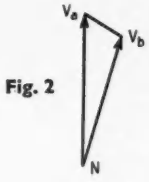


Fig. 2

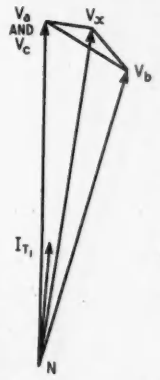


Fig. 3

determined by dividing by the current, and the short circuit MVA calculated by the formula above. A graphical solution as far as determining Rcb and Xcb simplifies the problem.

No mention has been made of the effect of load impedance, but in fact this method takes this into account and the solution is virtually correct for the particular load on the system when the test was carried out. The greater the load on system the greater the short circuit MVA, because of the regulation necessary to maintain the system voltage. Generally this fact is ignored in short circuit calculations.

When measuring Van, Vbn, Vxn and Vab a good quality voltmeter is required and several readings must be taken as the readings are not simultaneous and any variations during the test may cause considerable errors. A numerical solution of an example is given below:—

Example

A 500 kVA 5 per cent Z and 0·5 per cent R transformer is switched off on the m.v. side and the transformer voltage is 244 V per phase. The network voltage is 235·5 V and the voltage across the break is 11·3 V. When reclosed a current of 438 A is delivered at 240·3 V. The short circuit MVA of the supply to the transformer is 150 MVA. Calculations are in per cent and to a base of 500 kVA.

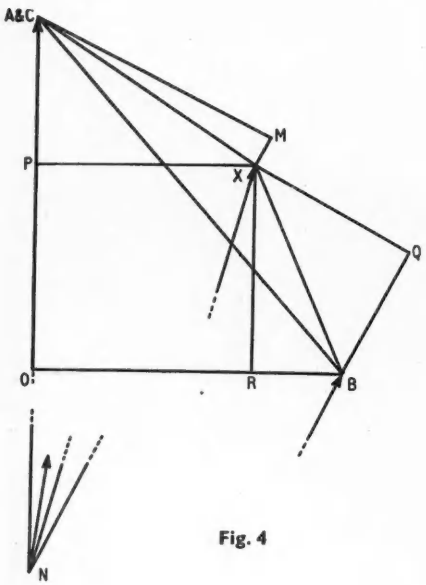


Fig. 4

Since Vab is small compared with Va it may be assumed that ON $\simeq$ BN and PN $\simeq$ XN.

$$\therefore CP = 244 - 240{\cdot}3 = 3{\cdot}7 \text{ V}$$

$$\text{and } AO = 244 - 235{\cdot}5 = 8{\cdot}5 \text{ V}$$

$$CX = 438 \times \frac{5}{100} \times \frac{415^2}{500{,}000} = 7{\cdot}55 \text{ V}$$

$$XP = \sqrt{7{\cdot}55^2 - 3{\cdot}7^2} = 6{\cdot}6$$

$$OB = \sqrt{11{\cdot}3^2 - 8{\cdot}5^2} = 7{\cdot}43$$

$$OP = 8{\cdot}5 - 3{\cdot}7 = 4{\cdot}8$$

$$RB = 7{\cdot}43 - 6{\cdot}6 = 0{\cdot}83$$

$$XB = \sqrt{4{\cdot}8^2 + 0{\cdot}83^2} = 4{\cdot}87$$

$$\angle XCM = \sin^{-1}\frac{0{\cdot}5}{5} = \sin^{-1} 0{\cdot}1 = 5^\circ\,44'$$

$$\angle PXC = \sin^{-1}\frac{3{\cdot}7}{7{\cdot}55} = \sin^{-1} 0{\cdot}477 = 28^\circ\,30'$$

$$\angle OBX = \tan^{-1}\frac{4{\cdot}8}{0{\cdot}83} = \tan^{-1} 5{\cdot}8 = 80^\circ\,12'$$

$$\angle BXQ = \angle OBX + \angle XCM - \angle PXC$$

$$= 80^\circ\,12' + 5^\circ\,44' - 28^\circ\,30' = 57^\circ\,26'$$

$$BQ = \sin 57^\circ\,26' \times 4{\cdot}87 = 4{\cdot}12 \text{ V}$$

$$XQ = \cos 57^\circ\,26' \times 4{\cdot}87 = 2{\cdot}62 \text{ V}$$

Per cent R of network between c and b in Fig. 1 =

$$\frac{4{\cdot}12}{438} \times \frac{500{,}000}{415^2} \times 100 = 2{\cdot}74 \text{ per cent}$$

Per cent X of network between c and b in Fig. 1 =

$$\frac{2{\cdot}62}{438} \times \frac{500{,}000}{415^2} \times 100 = 1{\cdot}74 \text{ per cent}$$

Total impedance between c and x in Fig. 1 =

$$\frac{j\,5 \times (2{\cdot}74 + j\,1{\cdot}74)}{2{\cdot}74 + j\,1{\cdot}74 + j\,5} = \frac{j\,13{\cdot}7 - 8{\cdot}7}{2{\cdot}74 + j\,6{\cdot}74}$$

$$= \frac{j\,13{\cdot}7 - 8{\cdot}7}{2{\cdot}74 + j6{\cdot}74} \times \frac{2{\cdot}74 - j6{\cdot}74}{2{\cdot}74 - j6{\cdot}74} = \frac{92{\cdot}2 - 23{\cdot}8 + j37{\cdot}5 + j58{\cdot}5}{7{\cdot}5 + 45{\cdot}2}$$

$$= \frac{68{\cdot}4 + j\,96}{52{\cdot}7} = 1{\cdot}3 + j\,1{\cdot}83$$

$$\text{Impedance of bulk supply} = 100 \times \frac{0{\cdot}5}{150} = 0{\cdot}33$$

(assumed all reactance)

$\therefore$ Total impedance of N to X

$$= 1{\cdot}3 + j\,1{\cdot}83 + j\,0{\cdot}33 = 1{\cdot}3 + j\,2{\cdot}16$$

$$= \sqrt{1{\cdot}3^2 + 2{\cdot}16^2} = 2{\cdot}51 \text{ per cent}$$

$$\text{Short circuit MVA} = 0{\cdot}5 \times \frac{100}{2{\cdot}51} = 20 \text{ MVA}$$

Welsh Water Power

THE Blaenau-Festiniog and Rheidol Valley hydro-electric projects were discussed in great detail before a Private Bill Committee of the House of Lords last week when the North Wales Hydro-Electric Power Bill, promoted by the Central Electricity Authority, was considered.

At the outset, Mr. Harold Willis, Q.C., for the Authority, was able to inform the Committee, whose chairman was Lord Terrington, that many of the objectors had withdrawn their petitions against the Bill and that the river boards in both the catchment areas affected by the proposed works had agreed that the measures proposed to safeguard the flow of compensation water in the diverted rivers were satisfactory.

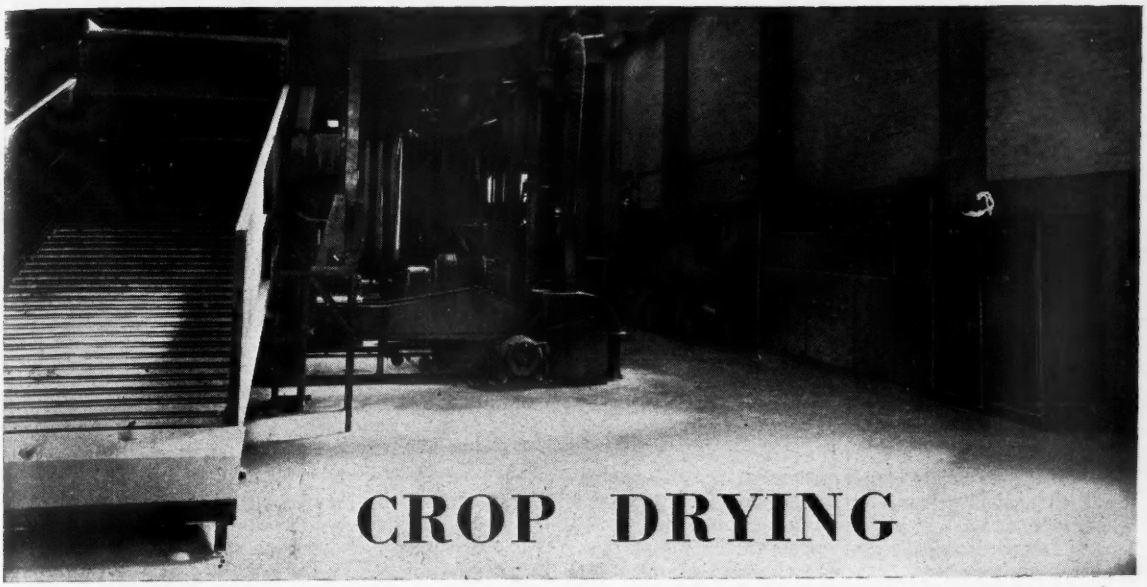
In the case of the Festiniog scheme, he said that originally there had been objections from the Merioneth County Council but after representatives of the C.E.A. had met representatives of that Council and of the Snowdonia National Park Joint Committee to explain the safeguards in the Bill, the objections were withdrawn. The Blaenau-Festiniog U.D.C. was strongly in favour of the project. He thought the Committee could assume from this that the authorities most closely concerned with agricultural river and amenity interests were satisfied with the safeguards.

Petitions against the Rheidol scheme were put in by the Cardiganshire and Montgomeryshire County Councils, said Mr. Willis, but they had been satisfied by a new clause, which had been agreed, to provide certain additional safeguards. The Aberystwyth Council had also withdrawn its petition on similar conditions.

In his general account of the proposals, Mr. Willis said there was a need to increase generating capacity to meet the expanding demand, which had gone up from 11,162 MW in 1948-49 to 15,000 MW in 1953-54 and an estimated 17,700 MW in 1954-55. In 1956-57 it was estimated that the demand would be 20,000 MW and in 1957-58, 22,300 MW. The Festiniog scheme was the first of its kind, of any size, in this country—a pumped storage system—in which the water would be used over and over again. Compared with the ordinary thermal station the pumped storage system showed very big savings in capital cost. All new projects had to be looked at in the light of nuclear generation and these two schemes did fit in most satisfactorily with nuclear generation. It was plainly in the public interest to use this natural water power, especially at a time when it was becoming very difficult to find suitable sites for ordinary generating stations.

The schemes would produce very substantial additions to the generating capacity of the Authority. The capacity of the pumped storage scheme would be 300 MW and that of the ordinary hydro-electric scheme at Rheidol would be 49 MW. Action would be taken to ensure that the buildings would fit gracefully into the scenery, and the pipelines would be camouflaged.

Counsel for the objectors were Mr. S. Cope-Morgan, Q.C., for the Festiniog Railway Company, part of whose historic line from Blaenau Festiniog to Portmadoc will be submerged in the reservoir to be created at the lower end of the Festiniog scheme; and Mr. H. Royston Askew, for the Council for the Preservation of Rural Wales, the British Mountaineering Council, the Commons, Open Spaces and Footpaths Preservation Society, the Ramblers' Association and the Youth Hostels Association (and the National Trust in respect only of the Rheidol scheme).



CROP DRYING

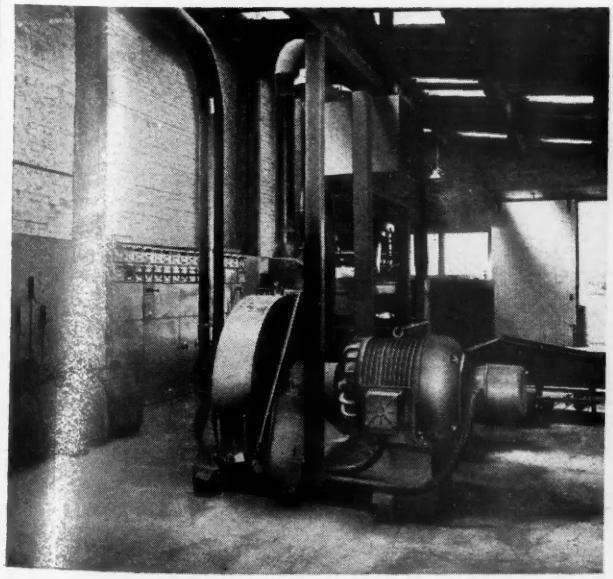
Well Equipped Installation for Grass and Grain at Lingfield

THE grass and grain drying plant recently installed for Mr. C. M. Bloomfield, at Stocks Farm, Lingfield, Surrey, is probably unique in the comprehensiveness of its mechanical handling arrangements and the elaborateness of the electrical control facilities. Equipped on lines more generally associated with factories, the plant has, in addition to the normal local push-button controls adjacent to the various motors, a central switch and fuse board giving supervisory control of the entire installation.

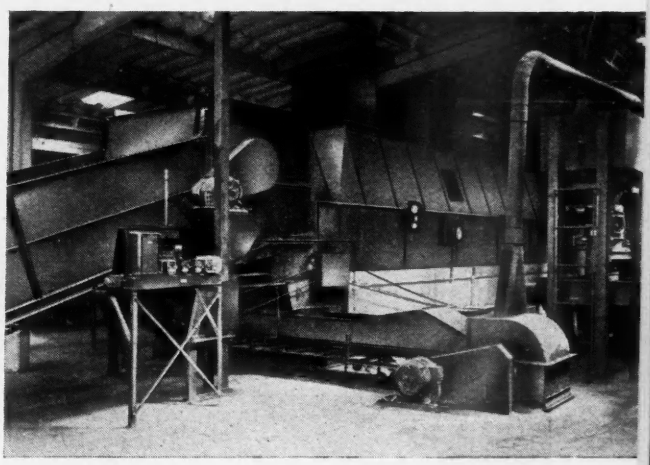
The oil-fired grass dryer, which is designed to handle up to 1,200 tons of grass in the season (about 25 weeks), is 110ft in length. Brought into the building on trailers, the grass is fed into a magazine spinner loader holding 30 cwt at one end of the plant. This loader, driven by a 4 h.p. motor, is made up of revolving tines, which ted the grass and spread a bed of even density on the higher of two conveyors running the full length of the dryer. This conveyor, together with another running below in the opposite direction, is driven through infinitely variable gear by means of a 1½ h.p. motor. In the drying process grass is carried through the dryer on the top conveyor and returned to the input end on the lower conveyor, during which time hot air at 300 deg F is blown through it at a rate of 30,000 cu ft/min by means of a 25 h.p. motor.

For safety purposes complete electrical interlocking has been provided on the dryer with the aid of thermostats and three " Satchwell " electrically operated valves. One of these valves, operating on the burner, has a by-pass controlling the high to low flame and working in conjunction with a thermostat. Each burner has another valve (without by-pass) which is interlocked with the motors on the primary air fan, the main dryer fan, etc.

Arriving back at the input end of the dryer, the grass,



Above: Spinner loader of grass dryer, the hammer mill and the group switchboard. Left: The hammer mill with the group switchboard in the background and (below) the grass drying plant

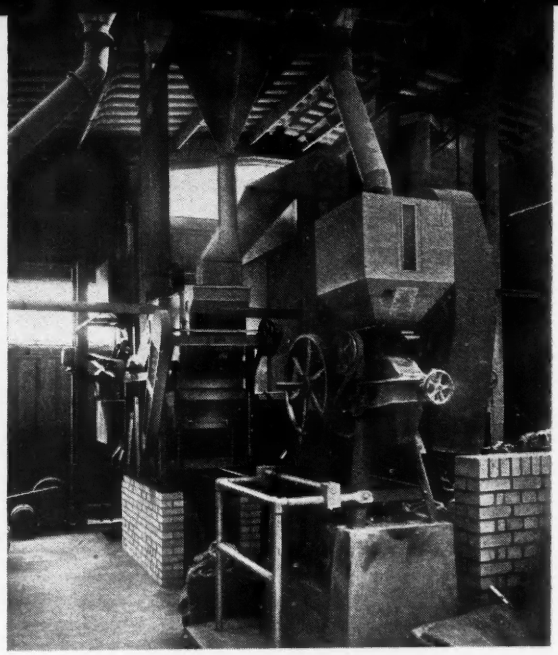


which has lost four-fifths of its weight during the drying process, is discharged on to a cross feed conveyor driven by a 1 h.p. motor. This conveyor can be run in either direction, to supply the baling press or to feed a pre-breaker (12½ h.p. motor) which chops the grass into ½in lengths and also removes stones, etc. In this chopped state the grass is then carried by suction through a mill of the swinging hammer type driven by a Brook 60 h.p. motor and incorporating 1·96 mm screens. From this hammer mill the grass passes, still under suction, to a cyclone which extracts the meal and exhausts through filters catching the very fine residue. The suction required for the conveying operations referred to is provided by a fan with a 7½ h.p. motor mounted on top of the cyclone.

From the cyclone the meal can either be bagged off or carried by an elevator (½ h.p. motor) to two 30 cwt mixers (4 h.p. motors) which are coupled together so that a continuous process can be carried out and any other desired ingredient added. From the mixers a further elevator carries the mixture to a cubing machine (25 h.p. motor) for producing cattle cubes and poultry pellets. The cubes are discharged into a bucket type elevator (1 h.p. motor) which carry them to a cooler (under suction from a 3 h.p. fan) to remove heat generated during the cubing process. Redler tidal controls actuated by mercury switches are employed both on the elevator feeding the cuber and on the cooler, in the latter case operating a bell when the cooler is full. A mechanical conveyor carries the cubes from the cooler to silos where they can be stored in bulk for winter feeding.

The completely separate grain drying plant is limited in its operation by the silo capacity which comprises twelve 50 ton concrete bins. It is fitted with a very large wet grain input hopper (280 cwt) so that it can operate continuously for twenty-four hours a day. From the dryer, which is also oil heated, the grain is pneumatically handled to the twelve silos which are in turn arranged so that the grain from any silo can be fed into a feed bin associated with the hammer mill already referred to. This enables the latter to be employed if desired for milling the grain when the grass dryer is not in operation. All the shutters for discharging the grain from the silos, etc., are remote controlled and interlocked with the cyclone motor control gear.

The whole installation is highly versatile and can combine the products of the grass and grain drying plants without any manual handling whatever. For working the grass



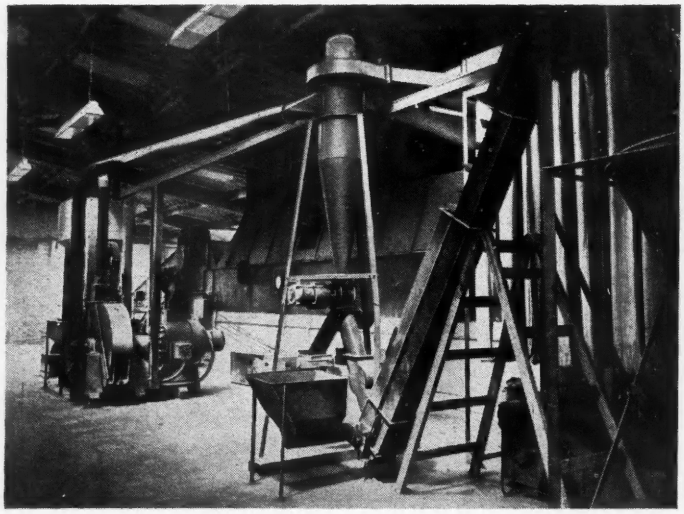
The grain drying plant

dryer and cubing plant there are two men and a manager whose time is also occupied with controlling the field work. There are also two men in charge of the grain dryer.

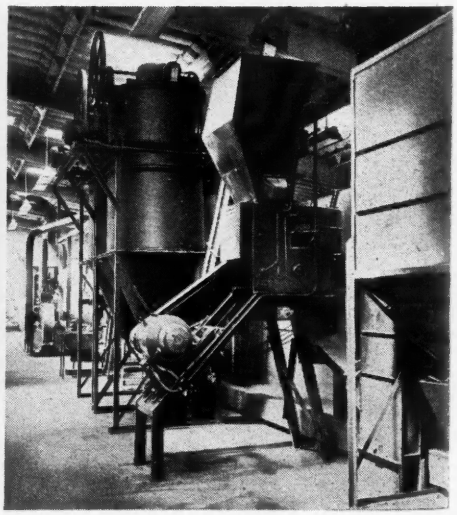
The installation was carried out to plans prepared by Mr. A. J. Stevens, L.R.I.B.A. The Templewood Engineering Co., Ltd., constructed and installed the grass dryer, and the milling, mixing, cubing and cooling equipment. E. R. & F. Turner, Ltd., were responsible for the grain drying plant, Geo. W. King, Ltd., supplying the grain handling equipment.

The electrical installation for power and lighting was carried out by the D.C. Engineering Co., Ltd., Guildford. The combined intake switchgear and control panels were manufactured by Varilectric, Ltd., Allen West & Co., Ltd., supplying the motor control gear. The plant throughout has a very efficient lighting installation utilizing Benjamin "Flurolier" fittings with "Crysteel" vitreous enamel reflectors housing 80 W fluorescent tubes. The visual conditions are excellent and the clear glass visors fitted to the reflectors form totally enclosed units which can be maintained without the need for frequent cleaning. Instant start control gear is used, and whilst single fittings are installed, they are wired with the twin lamp circuit.

The hammer mill and cyclone



Mixers, cubing machine and cooler



REDUCTION OF WIRING COSTS

A Comparison of Conduit Systems

By T. C. GILBERT, M.I.E.E.

THE present drive for more adequate wiring of new houses and flats cannot be fully successful unless the consumer can be assured that the additional socket-outlet and lighting points will not be unduly costly. Our present methods are most extravagant as compared with those of other countries, but we pride ourselves on the superiority of our installations. The position has now been reached, however, that if any considerable increase in the number of points, for the greater convenience of the consumer and, to a lesser degree, in the interests of electrical safety, is contemplated, then wiring costs must be substantially reduced.

This will apply in the main to blocks of flats and large private houses, as probably the almost universal tough-rubber jobs as installed in council and similar housing schemes have reached rock-bottom as regards costs; in fact, judging from tenders recently submitted for this type of work some contractors are pleased to do this wiring without profit. In the larger blocks of flats, however, heavy gauge steel conduit holds the field, with installations already too costly, apart from the visualized increase in the number of points, and it is towards this type of installation that these comments are directed.

Although the ring circuit has represented the greatest single step forward towards reduced wiring costs since the war, it has not received the widespread adoption visualized when the Post-War Building Study was published—ten years ago. In the writer's view, it is quite useless to advocate such things as skirtings with enclosed conductors forming almost continuous runs for socket-outlets, revolutionary troughing systems, or any unorthodox methods, as these are foreign to our traditions and will not be readily acceptable by the conservative wiring industry; we have always had a conduit and shall probably always require one if we are to feel that a job has been well done and has the withdrawable conductors considered essential in any well-planned job.

Labour Costs

In any search for reduced costs, systems must be adopted that make less call upon that most expensive item—the labour component. As one who has actually used and installed heavy gauge screwed steel conduit the writer has full knowledge of the unproductive time spent in ensuring continuity between conduits and fittings; hours are spent fixing and adjusting back-entry outlet boxes, with their bits and pieces, whilst half-a-dozen runs down to a distribution board may occupy a whole day. Many lengths of conduit are scrapped because the operative does not think they look good, or do not quite match the adjacent runs, but it is not the waste of materials that matters so much as the time. When all has been completed the unfortunate run exhibiting a slightly too-high continuity test has to be gone over again—possibly another day's labour.

It is alleged that wiremen are not as speedy these days as they used to be, but this may be because we have lately realized the extreme importance of impeccable continuity, and have impressed this upon the operative, with the result that the work must be unhurried. Even greater care must be taken in the future, with the foreshadowed heavy and light current continuity tests associated with the new impedance limit requirement, and this cannot be afforded if additional points are to be installed, for even if they are run from a ring circuit each socket-outlet means brass bushes, conduit sockets and careful fitting to every steel box, each one a potential source of weakness when the final tests come to be made.

The heavy current tests now visualized will disclose many more doubtful conduit joints than has been the case in the past, when we were content with simple resistance measurements, and it is not beyond the bounds of possibility that unproductive hours will be spent in tracing them. In the London area every such unproductive hour will cost about 12s, and in a large block of flats a week may be occupied in such work.

This article is in no sense an attack upon heavy gauge steel conduits. It is well known that many hundreds of thousands of apparently good installations have been made with this established system and for some applications it cannot be bettered; one E.D.A. publication describes it as " unquestionably the best of all wiring methods," but it cannot ensure the increase in convenience points desired by this body. To many installation engineers it is the one and only system in existence and no other is contemplated even for unsuitable conditions.

Craftsmanship

Operatives, too, resist any simplification of wiring system, considering this as likely to undermine their craft, for the skilled man cannot exhibit his superiority over the lesser skilled if the system is too simple. This attitude is laudable, if mistaken, and is fully understood by the writer, who recalls that in the early days of steel conduit operatives resented the disappearance of wood casing for the same reason. It usually means the exchange of an old skill for a new one, but the operative must be convinced that the new system really does represent an advance in installation technique if he is to take to it in the proper way.

However, standards are being raised and additional safeguards demanded, chiefly in the direction of lower impedance conduit runs, and the inescapable increase in installation costs cannot run parallel with any crusade for an increased number of outlets. It is therefore suggested that attention must be given to some alternative systems, combining our ingrained demand for a conduit with a great reduction in labour costs. It will not signify if material costs are slightly higher than at present, if only the labour component on the job can be reduced, and both objectives are obtainable. The target is an increased number of points in every house and flat with, if possible, a reduction in cost—certainly not any increase in cost—and not merely exhibitions of expert pipe fitting.

Non-Metallic Systems

The writer is probably known as an advocate of non-metallic conduits, particularly of the flexible variety, and long experience of installation work has resulted in the development of simple and inexpensive wiring systems. Many successful installations in blocks of flats have been made with this material and some authoritative documentary evidence is available concerning the very considerable reduction in overall costs as compared with steel conduit.

Such saving will be even greater in the future, with the new requirements for quadrupled testing of steel conduits, with d.c. and a.c., heavy and light currents, as with non-metallic conduits all such tests are eliminated entirely. Not only are installation costs reduced, but the contractor's nightmare of possible doubtful continuity, necessitating considerable expense in rectification later, for which he will obtain no redress, is entirely removed.

Space does not permit a full examination of other advantages accruing from non-metallic conduit systems, such as complete freedom from condensation troubles, immunity from corrosion and, probably most important, elimination of maintenance costs; conductor insulation never breaks down in conduits free from moisture and themselves of high insulating value. Apart from reduced costs, therefore, non-metallic conduit systems may be claimed to represent a definite advance in installation technique, electrically superior to metal conduit systems if not mechanically so.

Even so, the amount of abuse and mechanical disturbance that a properly-selected non-metallic conduit will put up with has to be seen to be believed. Where installers have complained that non-metallic conduits are not as robust in withstanding severe building conditions as they would like it is invariably found that the wrong type of conduit has been used; contractors who would not dream of placing light-gauge steel conduits under concrete or screeding cheerfully select the lightest gauge of non-metallic conduit for this work, instead of the heavier gauges especially designed for it. The writer has knowledge of several flat installations in which light-gauge conduits have been used, and they will remain satisfactory once safely in; much depends upon intelligent lay-out, as non-metallic conduits may be run in all kinds of unorthodox positions.

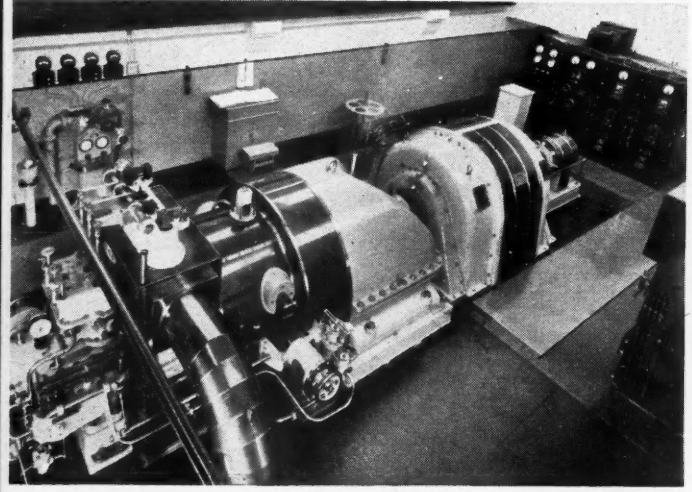
Of course, the old stand-by is often advanced—"What about nails being driven through the conduits?" The writer does not visualize the average householder as going round with pockets full of nails and a large hammer, seeking where he may drive them in to create the greatest havoc, and in flat installations there are few positions where other trades are liable to insert nails. If it should happen, repair is simple, the withdrawal of the nail being all that is required; there is no dangerous burr left inside the conduit and the hole will close against the entry of moisture. Only heavy gauge steel conduit can be considered as reasonably immune from possible nail damage; all other systems are vulnerable, and repair work is difficult and expensive.

Another point is, that installation engineers, having for so long been used to spouted accessories with long threads, are hard to convince that simple push-fits between conduits and accessories can possibly be damp and moisture proof; actually, the conduits are not only waterproof but water repellent, and it is extremely difficult to persuade water to flow along them. Long horizontal runs may be made between socket-outlet points without any fear of collected moisture damaging the conductor insulation, and the fact that conduits are self-threading into normal conduit entries, such as distribution boards and control gear, and require no additional internal bushes, makes for considerable economy in labour and material.

Once the innate conservatism of the industry can be overcome it is felt that a general recognition of the technical advantages of insulation reinforcement for conductors will be conceded, but the immediate necessity is for a reduction in costs. With experience, installation engineers and operatives will realize that non-metallic conduits are not put forward as an alternative, or substitute, for steel conduits, but as representing an advance in installation technique.

Pass-Out Turbo-Generator Set

AT the Kinleith Mill of Henry Bruce & Sons, Ltd., Midlothian, the General Electric Co., Ltd., has recently installed a 3,000 kW pass-out condensing turbo-alternator set. This machine is directly coupled and the turbine is capable of passing out a maximum of 55,000 lb/hr of steam at a pressure of 28 lb/sq in. The steam pressure and temperature at the turbine stop valve are 315 lb/sq in and 730 deg F. The set will maintain an output of 2,500 kW with no steam being passed out, when supplied with 2,300 gal/min of circulating water to the condenser at 65 deg F.



G.E.C. 3,000 kW pass-out turbo-alternator set

The single casing turbine has a normal running speed of 3,000 r.p.m. and a trip speed of 3,300 r.p.m. It has seven single stages and one Curtis stage to the pass-out connection and five single and one Curtis stage from the pass-out connection to the condenser. All moving blades are manufactured from stainless steel. Diaphragms before the pass-out are mild steel with stainless steel blades; the remainder are cast iron with stainless iron blading: the nozzles are fabricated from stainless steel. Controlled centrifugal governing of the spring type is fitted to the turbine.

The revolving field alternator is directly driven by the turbine and has a closed air circuit system of ventilation. The machine generates at 3,300 V, 50 c/s, 3-phase and will give the rated output with a power factor of 0·8.

The surface type condenser supplied by Hick Hargreaves & Co., Ltd., is mounted in a basement beneath the turbine exhaust branch. Steam jet operated air extraction equipment of the two stage type is provided with inter-stage and after-stage coolers, enabling the heat in the steam used to be recovered in the condensate. The plant has a cooling surface of 2,820 sq ft and is capable of condensing steam at 29,900 lb/hr while maintaining a vacuum of 28·08in when supplied with 2,300 gal/min of cooling water at a temperature of 65 deg F.

J. D. Crozier & Partners are the consulting engineers responsible for the installation which forms part of a complete power plant reconstruction scheme.

VIEWS on the NEWS

By REFLECTOR

AT the annual dinner of the Association of Supervising Electrical Engineers last week, Sir Norman Kipping, director-general of the Federation of British Industries and, incidentally, a member of the Institution of Electrical Engineers, drew attention to the serious loss to the balance of trade with other countries through inability to export coal in the quantities once possible. In this field as well as at home we cannot afford to wait for the relief which will come from atomic power stations a few years hence. In the meantime, as he pointed out, much can be done by supervising engineers in promoting the efficient use of fuel. Waste of heat energy in its use, I am authoritatively informed, is probably four times as much as losses owing to obsolete methods of steam raising; improvements should therefore cost much less in money and effort. In many instances the National Industrial Fuel Efficiency Service should be able to give practical help based on wide experience.

* * *

Having occasion recently to consider the industrial use of temperatures below freezing point, I was most interested in some practical information on the subject which was given recently by Mr. H. E. Charlton to the Manchester Association of Engineers. The most important difference in design of apparatus for temperatures above and below zero, he pointed out, lies in the much greater rate at which the cost of producing cold goes up as temperature is decreased. The extent of the difference in energy required, which I find is not always appreciated, is illustrated by the use of more than thirty times the amount of fuel to reach minus 180 deg C as would be required to raise the same amount of heat in the form of steam to the same temperature above zero.

* * *

Although we in this country are apt to follow American practice in a number of directions, an article in the *Electrical World* sets out the case for changing to 240/416 V as the standard utilization voltages in that country. It is pointed out that about 60 per cent of electricity consumers outside the United States receive service at approximately these voltages and there is the possibility of establishing a world standard. This, the author says, besides resulting in considerable economies, would remove an important barrier to the sale of American appliances in foreign markets. Conversely, of course, it would also help British manufacturers to sell their goods in America without the need to make special equipment for the purpose.

* * *

It has been ruled by the Minister of Education that what the *Sheffield Telegraph* calls "the educationally subnormal special school to be erected at Swinton" must not be heated by gas or electricity but by a solid fuel type of apparatus. No mention is made of the grounds for this decision, which the West Riding Education Committee has had to accept. A coke-fired installation is to be installed at an estimated cost of £1,888. It would have been interesting to have the cost of an electrical system, say floor warming or thermal storage, either of which lends itself to off-peak tariffs. Thanks, however, to persistent propaganda the idea of solid fuel has become firmly rooted even though the fuel is often not too solid or obtainable.

* * *

In the absence of London newspapers, many people (myself included) have had to rely to a greater extent on the radio to keep abreast of current affairs. An interesting talk last week was that of Sir Christopher Hinton, managing director of the Industrial Group of the Atomic Energy Authority. Asked whether electricity would become as cheap as water when Britain's atomic power stations plan became a reality he said "I shouldn't think so for a minute. I would not suggest that nuclear energy is going to reduce the price of electricity to such a level that one could possibly contemplate us doing that." With regard to supplies of uranium, he said that the number of high-grade ore deposits in the world was limited but a great deal had already been done in developing the processing of low grade ores. A large amount of the uranium being used now came from South African ores which were mainly low grade. With further development of processing uranium supplies should be reasonably adequate. Atomic station reactors would be perfectly safe in towns. They only involved the same sort of hazards as those in storing toxic gases under pressure. He agreed that the supply of technical manpower was one of the most difficult problems in connection with the programme. But the work was of such a pioneering and exciting type that certain people would sooner do it than anything else.

* * *

Atomic energy is, of course, the subject that springs first to mind when forecasting developments during the next two or three decades, but it is by no means the only one. In an article in *Fortune* and published in abstract form in the *Reader's Digest*, Mr. David Sarnoff, chairman of the Radio Corporation of America, refers also to "electronic light" which, he says, is being developed in the R.C.A. laboratories. Light amplification in ratios of more than 20 times the original has already been achieved experimentally and when the ratio reaches 100 a practical light amplifier will be obtained. "Produced directly within a thin layer of electronically active material, it will free electric light from the prison of a vacuum bulb." In the sphere of nuclear energy Mr. Sarnoff goes farther than many others in forecasting direct conversion into electricity and declares that "atomic batteries will be commonplace long before 1980."

PARLIAMENTARY REPORT

IN the House of Commons last week Mr. Janner asked the Minister of Works if he was aware that some of the large engineering firms in the country had announced the formation of a joint team of nuclear physicists, engineers and boiler technicians to study the problems of designing larger and more powerful atomic power stations for industrial nuclear power development; and if he would appoint liaison officers to maintain contact between this team and Government departments.

Mr. Birch replied that these teams had been formed by the firms concerned under the auspices of the Atomic Energy Authority and the electricity authorities to work on the design of the nuclear power stations in the ten-year programme outlined in the recent White Paper.

Asked to what extent the library of the Atomic Energy Authority could be used by members of the general public who wished to study the latest information on the peaceful and warlike uses of atomic energy, Mr. Birch said that the public could borrow books and papers from the Authority's libraries through the national interlibrary lending system. Application should be made through a local public or university library.

Bricks from Power Station Ash

Mr. Norman Dodds asked what practical application had been made of the successful experiments at the Building Research Station of producing good quality bricks from 85 per cent pulverized fuel ash waste and 15 per cent clay.

Mr. Birch said that the large-scale application of the results of these experiments raised technical and economic problems which the brickmakers were considering. Some brickmakers were now using a small proportion of fly ash in their regular production.

Mr. Dodds asked if the Minister was optimistic about the future of this proposal. Mr. Birch said it was not an easy matter. It was not economic to transport fly ash any great distance. One had to have suitable clay and fly ash close together. The matter raised a lot of problems.

Tenders for Overseas Contracts

Mr. Jay asked the President of the Board of Trade what steps he proposed to take to restrain United Kingdom firms from agreeing on identical prices when tendering for contracts overseas.

Mr. Henry Strauss, Parliamentary Secretary, Board of Trade, said that they had no powers to intervene, except where the Monopolies Commission had reported that such an arrangement was against the public interest.

Mr. Ivor Owen Thomas asked the President of the Board of Trade if he would make a statement on the present arrangements in regard to cable firms of this country tendering for contracts for cable developments in New Zealand and other Commonwealth countries; and if he would take steps to prevent the collaboration which at present took place between such cable firms.

Mr. Henry Strauss replied that the President of the Board of Trade was aware of these allegations and would take account of them in selecting further matters for reference to the Monopolies Commission.

Radioactive Contamination

Mr. Arthur Henderson asked the Prime Minister whether he would now agree to publish a White Paper containing all available facts and information, together with the report received from British scientists, on the effects of continuing radioactive contamination of the world's atmosphere.

Sir Winston Churchill replied that the Government had already invited the Medical Research Council to review the existing scientific information on the medical aspects of nuclear radiation and to prepare a report. The report would review existing scientific information and set forth the most up-to-date information and the latest research results available. It would be published as a White Paper.

Radio Interference Regulations

Mr. James MacColl moved the annulment of the Wireless Telegraphy (Control of Interference from Electric Motors) Regulations and the Wireless Telegraphy (Control of Interference from Refrigerators) Regulations. He said he had tried to find out what the Regulations meant. He discovered that the first applied to electric motors "having a continuous rating of less than 1 horse power per 1,000 revolutions per minute," but how many people knew whether their vacuum cleaner or refrigerator had such qualities?

Having found the matter to which the Regulations applied, one had to comply with the requirement that "when the electric motor is used the voltage of electro-magnetic energy at the electric supply terminals of the electric motor, as measured and computed . . . shall not exceed 1,500 microvolts where the measurement is made at any frequency between forty and seventy megacycles per second." That might cause a certain amount of difficulty for the conscientious housewife! To find whether one was conforming to the law one had to use a "calibrated radio receiver" and he read that "attenuators calibrated in decibels shall be provided in the input circuits of both r.f. and i.f. amplifiers." The regulations kindly explained: "The term decibel (abbreviated db) expresses the logarithmic ratio of two voltages or e.m.f.s. The ratio of the two voltages V_1 and V_2 expressed in decibels is 20 times the logarithm to the base of 10 of $\frac{V_1}{V_2}$ . . ." It was important to know, also, that the references to the voltage of a sine wave were to its "effective or root mean square value."

Sir Edward Boyle, Parliamentary Secretary, Ministry of Supply, replied to the debate in the absence of Mr. Gammans, the Postmaster-General, through illness. He said that under the first of the Regulations now being considered every electric refrigerator manufactured, assembled or imported after 1st September this year must be fitted with any necessary suppressors. If other refrigerators caused interference they would be subject to the second set of Regulations, dealing with small electric motors. This laid down that after 1st September the owner of any new or old appliance which contained a small motor and caused interference with radio or television sets could be compelled to stop the interference.

At the Post Office 2,800 complaints were received about refrigerators in 1954; there were 10,000 complaints about sewing machines; 7,500 about hair dryers; 4,300 about vacuum cleaners; and 3,500 about electric drills. With few exceptions suppressors were fitted without demur when investigations were made.

There were, of course, many kinds of electrical appliances which did not use small motors, such as electric lamps, electric blankets and sun-ray lamps. These were not yet covered by Regulations and the Postmaster-General would be receiving advice on them at a later date. The same applied to neon signs, which accounted for 1 per cent of the interference cases which the Post Office had investigated. With regard to interference caused by television sets to radio sets, one of the conditions under which a television or radio licence was issued was that it should not cause interference with any other radio apparatus. The House would be glad to learn that the Post Office had had to withdraw only three licences for this reason. This was clearly a problem which should be tackled at the manufacturing end and the Post Office was discussing it with the radio industry.

On the question of search, he assured the House that there was no automatic right of entry.

After a further short discussion the motion was negatived.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

The Minister of Fuel and Power has reappointed **Mr. W. J. Oswald,** A.M.I.E.E., of Wimbledon Park, London, as a part-time member of the South Eastern Electricity Board. **Lt.-Col. Sir Merrik Burrell,** Bart., C.B.E., J.P., of West Grinstead, Sussex, and **Mr. C. G. Morley New,** M.I.E.E., of Esher, Surrey, retired from the Board on 31st March, on completion of their terms of office.

Mr. C. J. W. Scott, executive director and general sales manager of Crompton Parkinson, Ltd., has been elected president of the Electric Light Fittings Association for the ensuing year. Mr. Scott was educated at Regent Street Polytechnic and joined Crompton Parkinson, Ltd., as sales engineer in 1930. He became assistant sales manager, lamp, cables and lighting departments, in 1939 and general sales manager, supplies division, in 1945. He was appointed an executive director in 1946. Mr. Scott is a member of both the Illuminating Engineering Society and the American Illuminating Engineering Society. He was chairman of the Electric Lamp Manufacturers' Association for 1953-54.

Mr. C. J. W. Scott

At the recent annual general meeting of the Association of Short-Circuit Testing Authorities, **Col. B. H. Leeson,** C.B.E., T.D., M.I.E.E., was re-elected chairman of the Association for the ensuing year.

Mrs. Jean S. Bambrick, for the last six years senior demonstrator for the South-East Scotland Electricity Board at Edinburgh, has been appointed assistant housecraft adviser with the refrigeration division of the Pressed Steel Co., Ltd.

The South of Scotland Electricity Board has announced the following appointments:—

Mr. E. **Hywel Jones,** M.I.E.E., M.I.Mech.E., becomes deputy chief engineer (generation). Mr. Jones served his apprenticeship with Cammell Laird & Co., Ltd., Birkenhead. After experience in Lister Drive and Clarence Dock power stations, he was appointed assistant station superintendent at Clarence Dock power station in 1943 and generation engineer at Tir John power station in 1944. From 1944 to 1948 Mr. Jones was deputy borough electrical engineer at Swansea and since 1948 he has held the appointment of chief generation engineer (operation) in the South Wales Division of the Central Electricity Authority.

Mr. James G. Curtis, M.I.E.E., A.M.I.I.A., is appointed manager of the Central Area, with headquarters in Stirling. Mr. Curtis served his apprenticeship with the Carlisle Corporation Electricity Department and remained with the Department in various capacities from 1930 until 1943. He then joined the Kirkcaldy Corporation Electricity Department as mains and power station superintendent, being appointed electrical engineer depute in 1944 and burgh electrical engineer and manager in 1948. He was planning engineer in the Fife Area from 1949 to 1950 and since that date has been engineer of the Fife Area.

Mr. Daniel Hart, Assoc.I.E.E., is to be commercial officer, Lanarkshire Area. Mr. Hart served his apprenticeship with the Electric Supply Corporation, Ltd., Dumbarton. From 1921 he held various appointments in the Corporation's undertakings at Dumbarton, St. Andrews and Chelmsford until his appointment in 1930 as engineer and manager, Seaford and Newhaven Electricity, Ltd. In 1942 Mr. Hart returned to the Electric Supply Corporation as engineer and manager of the Dumbarton undertaking, and since 1948 he has been commercial officer of the Ayrshire Area.

The General Electric Co., Ltd., has appointed **Mr. Timothy Ellis** an assistant secretary to the company. Mr. Ellis was educated at Repton and the Royal Military College, Sandhurst, and was gazetted into the Light Infantry in 1938. He took part both in the Dunkirk evacuation and in the Normandy landings and was twice wounded on active service during the war. During 1947-48 he served in the Sudan. On retiring from the Army with the rank of major he joined the G.E.C. in 1949 and has worked in the secretary's department for the past five years.

Mr. T. Ellis

Mr. A. Kendall, latterly chief television purchasing and stores officer to the English Electric Co., Ltd., Liverpool, has joined the Igranic Electric Co., Ltd., as radio buyer. Mr. Kendall will operate from the new radio and television component factory at Bromborough, Cheshire.

Mr. A. J. Murray has been appointed London sales executive of British Electric Lamps, Ltd., at the company's London showrooms at 229-231, Westminster Bridge Road, S.E.1 (telephone: Waterloo 4788).

Mr. E. G. Snelus, M.B.E., has been appointed sales manager at the metal works in Birmingham of McKechnie Brothers, Ltd.

Mr. C. Rowbotham, the district manager at Reigate of the South Eastern Electricity Board, retired on 31st March and **Mr. H. F. Gill,** the Sevenoaks and Horley district manager, has assumed additional responsibility for Reigate.

On 1st April the Derby Works of **International Combustion, Ltd.,** was the venue of a dinner and entertainment to over 100 members of the staff who have completed twenty years' service, or more, with the organization. The toast "The Old Campaigners and the Company" was proposed by Ald. A. Sturgess, O.B.E., J.P., member of the East Midlands Electricity Board, and replied to by Sir Bernhard Binder, F.C.A., director of International Combustion (Holdings), Ltd. This is the second long service dinner held at Derby. At the first, held in 1949, there were 372 employees present to celebrate twenty years' service.

The **Electrical Trades' Commercial Travellers' Association** (Midlands Branch) held its ladies' evening at the Queens Hotel, Birmingham, on 25th March. The function was attended by over 200 members and their guests representing most sections of the electrical industry in the Midlands area. Mr. R. A. Capel (branch chairman) presided. The toast to the ladies was proposed by Mr. A. B. Frost (branch vice-chairman) and Mrs. Capel responded. The guests included Mr. Arthur Haywood (national president), Mr. H. Bowen (national chairman), Mr. Walter Lewis (chairman of the Midlands Electricity Board) and several vice-presidents of the Association. The E.T.C.T.A. (Midlands) snooker trophy was presented to the winner, Mr. H. Woodfield, and the runner-up, Mr. J. Tranter, received a tankard. The Branch will hold a smoking concert at the Chapel Tavern, Great Charles Street, Birmingham, on 22nd April.

OBITUARY

Mr. J. Reginald Buck died on 30th March, aged forty-eight. He served an apprenticeship with Green & Smith, Ltd., electrical contractors, Leeds, and was appointed a director in 1934. He had thirty-one years' service.

Mr. E. J. Stockwell, of Tonbridge, Kent, died on 10th March. He was the first electrical representative employed by Falk, Stadelmann & Co., Ltd., having joined the company in 1903. In 1928 he started Falks Technical Department and retired in March, 1950.

WILLS

Mr. F. T. Alldread, former director of George E. Taylor & Co. (London), Ltd., who died on 14th November last, left £45,798 gross (£40,129 net).

Major A. H. L. Howell, A.M.I.E.E., managing director of James Williams (Narberth), Ltd., and for some time engineer-in-charge of the Haverfordwest electricity works, who died on 19th June last, left £40,085 gross (£38,840 net).

Mr. P. M. Pinder, M.I.E.E., superintendent of Ironbridge power station, 1932-53, who died on 27th September last, left £30,487 gross (£30,015 net).

Mr. J. H. Wears, O.B.E., formerly superintendent of the English Electric Co.'s tank shop at Stafford, who died on 16th November last, left £10,308 gross (£10,188 net).

Mr. E. Boys, M.C., F.C.I.S., formerly secretary of the Northmet Power Co., who died on 30th October last, left £10,941 gross (£10,770 net).

Mr. A. A. Selkirk, formerly London manager of William McGeoch & Co., Ltd., who died on 15th November last, left £6,885 gross (£6,826 net).

Mr. G. S. Ramage, secretary and financial director of the Harland Engineering Co., Ltd., who died on 19th November last, left personal estate in England and Scotland valued at £4,322.

Mr. R. E. Meade, first borough electrical engineer of Stafford, who died on 31st December last, left £28,775 gross (£28,352 net).

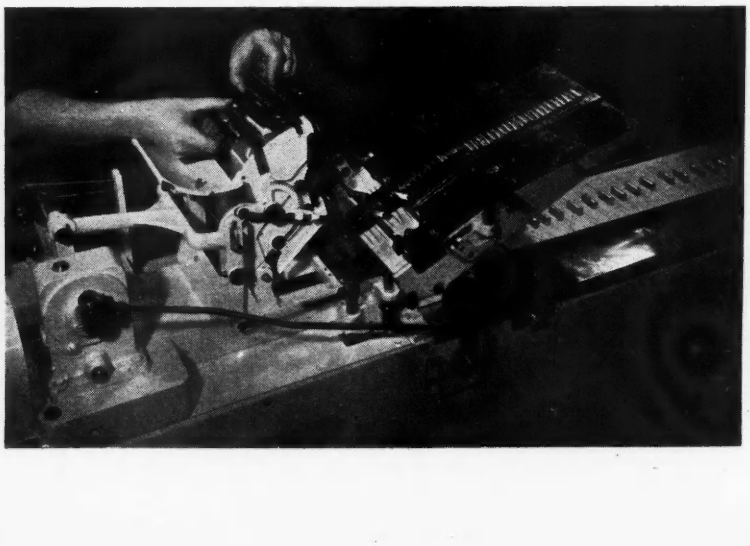
Mr. E. J. Frank, late managing director of E. F. Electric, Ltd., who died on 10th November last, left £22,084 gross (£21,433 net).

Marking Electrical Components

Rejafix, Ltd., 81-83, Fulham High Street, London, S.W.6, has recently put on the market two new models of its combined marking and printing machines for marking electrical components, designed to meet faster production needs. One is a power-driven machine, having six printing pads on a rotating table. This new arrangement reduces time lag between the prints and increases production speed. This model is also being used for fast production printing of flat surfaces. Where adaptable, automatic feeding and ejection devices can be designed to work in conjunction with the rotary table. This model is made in two sizes and covers the printing and marking requirements for a large range of electrical components of diverse shapes and sizes. Like all other Rejafix machines, it employs the use of zinco metal printing blocks or printing type which are positive. A negative inked impression, made with special inks to suit the material printed on, is deposited on the surface of a flat resilient offset pad. The article, if round, is rolled over the impression, and if flat, is pressed down over the impression on the pad. By this means a clear positive marking is transferred back to the surface of the article.

The other machine is a fully automatic model for dealing with cylindrical articles only from ¼in to 1in diameter and up to 4½in in length. This machine is fitted with a hopper, which is adjustable for all sizes within this range. The hopper is open sided so that it can be bulk-fed by the operator. It is claimed by the makers that up to 3,600 articles per hour can be handled and printed on this machine.

Rejafix fully automatic machine shown printing on small electric resistors with wires attached



STREET LIGHTING NOTES

Two street lighting orders to the value of nearly £20,000 have been received by the British Thomson-Houston Co., Ltd., for the supply and erection of sodium equipment in CAERPHILLY U.D.C. Over 200 "Mazda Amber" sodium refractor lanterns will be installed on two main routes in the area, a section of the main Cardiff to Merthyr road between Taffs Well and Nantgarw, and the Caerphilly to Llanbradach road.

DONCASTER Town Council are to carry out a £1,100 street lighting improvement scheme in Waterdale.

Schemes for improving street lighting in seven streets in MAIDENHEAD by the use of Group "A" fluorescent, Group "B" fluorescent and Group "B" tungsten illumination are being prepared by the borough surveyor. It is planned to include these schemes in next year's lighting programme.

PETERBOROUGH Highways Committee reports that the Ministry of Transport and Civil Aviation has given preliminary approval to the scheme of improved lighting on trunk road A.47, from Newark Hill to the borough boundary, and tenders are to be invited for the carrying out of the scheme.

A report by the MORECAMBE and HEYSHAM Watch Committee says that the existing gas lighting is uneconomical and inefficient and suggests that the 812 gas lamps at present used in the borough should be progressively converted to electric lighting during the next eight years.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 16th April:

KLISCHOGRAPH. No. 729,523, Class 9. Physical and electro-technical apparatus; apparatus for transmitting pictures by radio and by telegraphy; and parts.—Dr. Ing. R. Hell, Kiel-Dietrichsdorf, Germany. Address for service, c/o Baron & Warren, 16, Kensington Square, London, W.8.

TUCOTACT. No. 733,346, Class 9. Electrical contacts and connectors.—U. Tuchel, Heilbronn, Neckar, Germany. Address for service, c/o H. A. L. Venner, 1, Great James Street, Bedford Row, London, W.C.1.

DENHILL. No. 736,807, Class 9. Electrical apparatus and instruments, etc.—C. J. D. Davis, D. N. Mulholland and V. C. Pike, trading as J. A. Davis & Co., 94-104, Denmark Hill, London, S.E.5.

RACAL. No. 737,209, Class 9. Electrical apparatus and instruments; radio, radar, television, telegraphic, telephonic testing and measuring apparatus and instruments; aerials, thermionic amplifiers and frequency meters; and parts.—Racal Engineering, Ltd., Western Road, Bracknell, Berks.

LADY ANNE. No. 737,802, Class 9. Radio, television and telegraphic instruments and apparatus, etc.; batteries and cases for torches or pocket lamps.—Vidor, Ltd., West Street, Erith, Kent.

SIERESCENT. No. 735,102, Class 11. Lighting installations and parts and fittings.—Siemens Electric Lamps & Supplies, Ltd., Caxton House, Tothill Street, London, S.W.1.

CLIPLUVE. No. 738,712, Class 11. Electric lighting fittings.—Tube Lamination & Engineering, Ltd., 19, Desborough Park Road, High Wycombe, Bucks.

Engineering in Europe

Abstracts from Foreign Technical Journals

ALTHOUGH the layout of earthing systems for large power networks is becoming more and more a matter for specialists, the many aspects of the problem and its bearing on the safety of comparatively large areas along and around overhead lines and substations, respectively, make it necessary for every power engineer to be acquainted with the theory of earthing, measuring methods and their reliability for determining dangerous contact and step voltages, etc. Nor can the modern communications engineer afford to neglect this subject since not only interference with telephone and even radio communications has to do with the quality of the earthing in neighbouring power systems, but there may be actual dangers for telephone lines and equipment when short-circuits in imperfectly earthed power systems occur.

A large amount of research work is done on this subject and the literature is growing so fast that the non-specialist cannot find the time to follow up even the most important publications, let alone assess correctly the many intricacies of the subject, e.g. geophysical factors influencing earth resistances, etc. For this reason the most valuable of the many publications for the non-specialist are those which succeed in outlining the basic problems, give a simple theory of the calculation of earth electrodes and earthing systems, with useful graphs of potential distributions produced by such systems and describe the measuring methods which are more or less easy to apply, without neglecting to give an idea of the more powerful laboratory methods which have become indispensable for the specialist, particularly that of the electrolytic tank. Also, the problem of the interconnection of protective and service earths must be discussed. The author of the paper set himself this task and carried it out with some success, considering the implications of the special case of a solidly earthed e.h.v. system.—" Earthing of Substations in V.H.V. Systems with Solidly Earthed Neutral," M. Zapletal, *Elektrotech. Obzor*, Vol. 43, No. 11, pp. 572-581, November, 1954, in Czech.

Testing Large Insulators

The special method described was evolved for detecting defects in the porcelain shields of 110-220 kV bushings, and particularly in their cemented joints. It is clear that the mechanical as well as the dielectric strength of a composite insulator depends greatly on the homogeneity of all its constituent parts as well as of the joints between them. However, the general suitability of any method of flaw detection in itself is not sufficient for rendering it generally useful for any special purpose and much work has been done in various countries on the development of ultrasonic flaw detection to suit all possible cases of insulator defects.

The particular problem solved by the author was the determination of the different speeds of propagation, reflection and refraction angles of ultrasonic waves in porcelain, glaze and cementation and to use the results for designing a " feeler " and pick-up unit transmitting the waves under the most suitable angle to the insulator tested and facilitating the analysis of the four reflected and refracted waves; this leads to the actual detection of irregularities, cavities, cracks and porous regions in the porcelain or the cementation. The " feeler " consists of a plexiglass prism with one face at an angle of 45 deg to which the piezo plate setting up the ultrasonic vibrations is cemented. The piezo material used is barium titanate. The theory and experimental results given confirm that the detection method developed is very sensitive and reliable, obviously non-destructive, and the outlay for the elaborate receiving, amplifying and oscillographic equipment as well as the time required for testing a large bushing are certainly justifiable and economically bearable.—" Ultrasonic Method of Detecting Defects in Large Insulators," V. N. Shchepetov, *Elektrichestvo*, No. 12, pp. 38-44, 1954, in Russian.

Installation Testing

An instrument for the rapid determination of the conditions of protective earthing and of earthing through neutral (if this particular earthing method is used) and also for determining short-circuit currents is described. It is based on the concept of the loop resistance which consists of the internal resistance of the source of the supply (in l.v. systems the distribution transformer) and the resistances of the feeders and service cables to the consumers with their returns which may be through earth. This may be determined by a comparatively simple voltage drop measurement in the loop (thus between one phase and the neutral) and since the " mains resistance " is also easy to measure, the earth resistance may be found by subtraction of the two resistance values measured. The loop resistance, once known, enables the short-circuit currents to be calculated.

The instrument has alternative connections for voltage and current measurements, and as the latter are only required for determining the loop resistances, the ammeter scale is graduated directly in ohms. The arrangement of the internal circuits of the instrument is such that contact resistances to floorings may also be measured and questions relating to correct fuse protection may also be answered.—" The Loop-Resistance Measuring Instrument for Testing Electrical Installations," W. Schrank, *E.T.Z.(B)*, Vol. 6, No. 12, pp. 429-431, 21st December, 1954, in German.

Reducing Switching Surges

On breaking a small inductive current the arc set up in the quenching chamber may carry either an increasing or a damped h.f. current which may be ruptured prematurely or be quenched according to the character of the " h.f. zero-passage." If an idling line is connected between circuit breaker and supply, the excitation and frequency of the arc current are reduced; despite this fact, the voltage surges become larger in the case of an idling line, as can be proved theoretically as well as experimentally (in the Swedish h.v. system of Standsforsen). The amplitude and steepness of the switching surge waves stressing an idling transformer are theoretically predictable.

Of the two methods of reducing switching surges, viz. stabilization of the arc by the insertion of a series resistance

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

or by reducing the effect of the quenching medium, and limitation of the surges after arc rupture by shunt resistances, spark gaps or surge diverters, only the second method is really practicable and successful. If necessary, it may be combined with a means of reducing the effect of the quenching medium in the case of small breaking currents. The theoretical treatment of the problem presented uses operator methods and Laplace transforms.—"Arc Current and Voltage Surges on Breaking Small Inductive Currents in H.V. Systems," P. Baltensperger and P. Schmid, *A.S.E. Bull.*, Vol. 46, No. 1, pp. 1-13, 8th January, 1955, in German.

Supervising Electrical Engineers

Annual Dinner and Reunion

THE annual dinner and reunion of the Association of Supervising Electrical Engineers was held on 1st April under the chairmanship of Mr. Bryan Donkin, its president.

Proposing the toast of "The Electrical Industry," Sir John Cockcroft (director, Atomic Energy Research Establishment) referred to the close collaboration in the production of electricity which was now beginning between the Atomic Energy Authority and the Central Electricity Authority, both of which were directly founded on science. He doubted whether Faraday when he discovered electromagnetic induction in 1831 could have foreseen the consequent great development of the electrical industry. Indeed it was fifty years before the first dynamo supplied electric light on a modest scale. In 1890, about the period of the Parsons turbo-generator, the kWh sent out were only one-thousandth of to-day's figure, which was expected to be more than three times as great by 1975. It seemed certain that the aid of nuclear power will be required.

Fifty years ago Rutherford predicted that control of the rate of disintegration of radioactive elements, if found practicable, would yield an enormous amount of energy from a small quantity of matter. This was accomplished twenty-eight years later by artificially speeding up particles and Chadwick discovered the neutron, which provided the key that five years later was used to secure uranium fission.

Power Stations of the Future

From experience gained during the war in Canada, where two heavy-water piles were built, four graphite piles were built, two at Harwell and two at Windscale. Graphite was much cheaper than heavy water, which cost £100 a glass. The Government's programme, aimed at saving annually up to 6 million tons of coal through the use of nuclear power by 1965 and 40 million tons by the 1970's, was based on experience gained in designing Calder Hall power station now under construction in Cumberland. Reactor development would undoubtedly differ greatly in detail from the first plan, and the output of nuclear power units would go up by factors of at least five within a decade, while sizes and capital cost would come down. Steam power stations, without coal or ash, would become as hygienic as hydro-electric stations.

Much of the research and development effort over the next ten years would be provided by the Atomic Energy Authority, but industry would soon be able to design and build power stations for the Central Electricity Authority. For the time being the A.E.A. was taking on some university functions and teaching the new technology to students, including staff of the C.E.A.

Responding, Mr. J. Eccles (president, Institution of Electrical Engineers), after mentioning examples of recent progress, such as the 200 MW generating set (weighing 2,200 tons) now on order, the ability to send a radio message round the world in one-seventh of a second and the development of radio-telescopes that seemed to reach nearly to the edge of space, referred to Sir John Cockcroft as the first person to persuade matter to disintegrate forcibly. He was therefore the father of nuclear power and had put Great Britain in the forefront of nations in this respect.

The need for nuclear power to supplement coal and oil in the future was indicated by the growth in the electrical demand during the past seven years of 75 per cent (from 9,500 MW in 1947-1948 to 16,600 MW for the year ended 31st March, 1955). The Association members furnished the link between public supply and users of electricity. Consumers were not interested in electricity as such but only in the services it provided. Another aspect was that last year the electrical manufacturing industry exported £218 million worth of goods making it again the second largest exporting industry.

Association's Activities

Seconding the response, Mr. S. H. Harding (national chairman, A.S.E.E.) said that the function at which the attendance of over 700 passed all records, marked the end of the forty-first year of the Association. The presidential address had likewise attracted the greatest number yet. During the past twelve months well equipped offices had been opened in London. There had been 52,000 visitors to the electrical exhibition, which had been featured on television, while the dinner had been announced by the B.B.C. among the day's important events. No fewer than 370 technical lectures had been given during the session. The greatest need of the country was for real engineers who should be attracted by adequate remuneration.

The health of "The Guests" was proposed by the chairman, who briefly summarized the contributions to the economic and scientific life of the country which had been made by the speakers and by Sir David Brunt, who was also present. He emphasized the part played by private enterprise in productive industries in collaboration with publicly owned consumer industries which had become an essential part of the country's economy.

Sir Norman Kipping (director-general, Federation of British Industries), replying, dwelt especially on the coal situation. During this hard winter stocks of 7½ million tons had been used and 2½ million more should be raised to build up to the 5 million tons of last summer. Last year the value of 35 million tons had been lost to the country through inability to export, mainly to Norway, Sweden and Denmark, and there was the likelihood of a loss of former business connections abroad. Neither nuclear power at present nor railway electrification nor the efforts of the miners could fill the gap; £25 million was spent on fuel necessarily imported. Exports of 55 million tons of coal as in 1930 at to-day's prices would have brought in £250 million.

Sales Training Centre

New Eastern Electricity Board Establishment

To meet the increasing demand for electrical appliances, the Eastern Electricity Board is making sure of an adequate supply of well trained, courteous staff in its service centres and for outside business. To this end the Board has established a sales training centre at Ipswich which was opened on 14th March by the chairman of the Board, Mr. C. T. Melling, C.B.E.

On this occasion Mr. Melling pointed out that the amount of electrical merchandising carried out by the Eastern Board was higher than that of any other Electricity Board in the country. He also reminded his audience that the Board's duty was to serve the public. Showing consumers how they could get the best value from their electricity was one way of achieving this.

For some years the Board has had "short term" training schemes run by staff members, but with continual expansion there has arisen the need for a permanent residential training scheme. This will provide three separate and continuing full-time courses, each attended by about eighteen members of the staff selected from the whole of the Board's area. The students will be accommodated in three nearby guest houses.

Above: At the opening of the Ipswich sales training centre. Two students from the Suffolk Sub-Area talking to Mr. C. T. Melling (chairman, Eastern Electricity Board), Mr. E. A. Fowler (chief commercial officer) and Mr. H. Brierley (liaison and personnel officer)

Left: A group of students in the lecture room with Messrs. D. Jones (sales lecturer), D. K. Flockton (sales instructor) and (in the background) H. G. F. Gamble (assistant chief commercial officer)

Two full-time instructors have been appointed: they are Mr. D. Jones (sales lecturer) who was previously district commercial engineer in the St. Albans District and Mr. D. K. Flockton (sales instructor) who for the last two years has been T.W.I. trainer in the Board's Northmet Sub-Area.

The curriculum for new and recent entrants covers a wide range of subjects, including some of a semi-technical character to give the "students" a sufficient basis to answer questions which consumers are likely to put to them.

First there are introductory talks embracing the growth of the industry and the Board's organization. There follow lectures on the production and delivery of electricity; the need for a selling organization; electricity units; efficiency of utilization; meter reading; elementary wiring circuits; lighting; tariffs; sales facilities; simple appliances; application forms; internal and window display; refrigerators, water heaters and space heating; sales technique; personal relations; various aspects of salesmanship; and co-operation with other departments.

The centre has a full range of electrical appliances for demonstration and instructional purposes and particular emphasis will be laid upon practical demonstrations in the art of salesmanship. Lectures will include the use of instructional films and there will be a dummy service centre window for use in display techniques.

The other two courses, of the "refresher" type, which last for one week each, are designed for the more experienced members of the service centre staff and commercial assistants, including sales representatives. The aims of these courses are to acquaint the staff with Board policy and to show them trends in the latest designs of appliances approved for safety and efficiency by the Board's testing house.

An interesting feature of all the courses is the use of a tape recorder during those sessions dealing with practical interviews with consumers. When "played back" to the student this helps him to correct faults in speech or general manner in dealing with the consumer.

About three hundred and fifty students will receive instruction each year at the centre which, at the moment, is regarded as a "pilot" scheme; additional centres may be established in the future.

Illumination Design Course

The 70th London (Day) Illumination Design Course will be held from 10th to 13th May. Applications for reservations should be made to the manager, E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, London, W.C.2.

INDUSTRIAL NEWS

Kelvin Power Station, Johannesburg

The contract for the whole of the cabling for the new Kelvin power station of the Johannesburg City Council, for which Merz & McLellan are the consulting engineers, has been awarded to W. T. Henley's Telegraph Works Co., Ltd. The value of this contract is approximately £168,000, and includes the supply and installation of all cables, sealing ends and terminal boxes, and the earthing systems. In all, some 90,000 yd of cable of various types and sizes will be required, together with approximately 5,000 yd of copper earthing strip. The power station will be linked with the municipality's 88 kV system, and in consequence some 4,700 yd of 0·15 sq in, 88 kV single-core oil-filled cables and the associated special accessories will be provided as part of the contract.

All installation work, including jointing and terminating, will be carried out by Henley's South African Contract Department.

British Glass Industry Research Association

The British Glass Industry Research Association, formed under the auspices, and with the encouragement, of the Department of Scientific and Industrial Research, has been registered as a company, limited by guarantee. The establishment of this new research organization marks an important step in the scientific and industrial development of the British glass industry. It will take over from the Department of Glass Technology of the University of Sheffield and will thus continue the tradition of research work begun there during the first world war. The British Glass Industry Research Association and the Department of Glass Technology are now to be separately administered, although they will share the same University buildings at "Elmfield," Northumberland Road, Sheffield, 10. Dr. R. G. Newton has been appointed director of the Research Association and Dr. D. K. Hill assistant director. Mr. R. W. Douglas has been appointed to the Chair of Glass Technology at the University of Sheffield in succession to Professor H. Moore, who is retiring at the end of the session.

Batti-Wallahs' Society

Capt. George Eyston, the well-known motorist, was the speaker at last week's luncheon of the Batti-Wallahs' Society, Mr. C. N. Good, the president, introducing him as the holder of more land speed records than any other man. Capt. Eyston reviewed the gradual increase in car speed records from 1898 to the present day, and accompanied his talk with lantern slides and a film.

The Society's annual general meeting is to be held on 19th April.

European Metallurgical Meeting

The American Institute of Mining and Metallurgical Engineers and the American Society of Metals have accepted invitations from the Iron and Steel Institute and the Institute of Metals and from the leading metallurgical societies in Belgium, France, Germany and Sweden, to send representatives to a joint metallurgical societies' meeting in Europe. The dates of the meeting are, 1st to 7th June next in Great Britain, 9th to 12th June in Dusseldorf, 13th June in Liège and 14th to 18th June in France.

Baghdad Television Station

The prefabricated television transmitting station which was erected and operated at last year's British Trade Fair in Baghdad by Pye, Ltd., has been purchased by the Government of Iraq to form the nucleus of the country's television service. It will be re-erected near the existing broadcasting studios. The transmitters — 500 W vision and 250 W sound — are sufficiently powerful to cover the whole of Baghdad. The system used is 625-line standard C.C.I.R. signal transmitted on Band III, and the frequencies are 196·25 Mc/s vision and 201·75 Mc/s sound.

The Pye television station erected in Baghdad for last year's Trade Fair

City and Guilds Institute

The report of the Council of the City and Guilds of London Institute for 1953-54 just issued contains abridged reports on the activities of the various departments, a list of members of the Institute including the Council and Executive Committee, lists of members of the various committees, representatives on other organizations, fellows of the Institute and other information.

Thermodare Sales Conference

The annual conference of Thermodare (Great Britain) was held recently at Marsham Court, London, S.W.1, and was followed by a dinner given to the staff and area managers. During the function Mr. E. C. Green, manager, presented wallets and cheques to Mr. E. Smith (West Country) for the largest area turnover for the year, Mr. H. Dennell (Yorkshire) for the largest individual monthly sales, and Mr. S. A. Woods (North West area) for the largest individual contract.

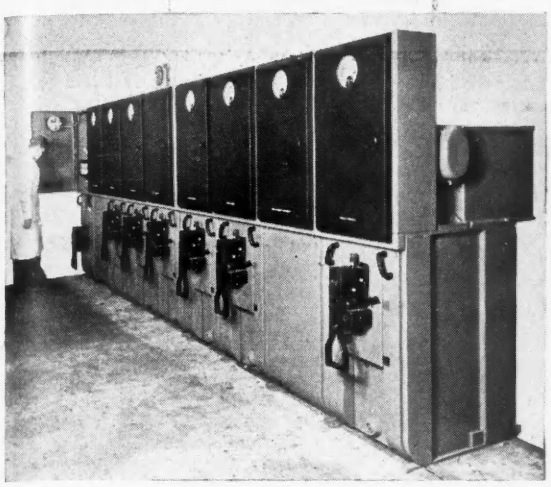
Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Monday last.

ALUMINIUM Ingots	ton £163 0s 0d
COPPER, H.C. Electro	ton £364 0s 0d
Fire Refined 99·70%	ton £363 0s 0d
Fire Refined 99·50%	ton £362 0s 0d
COPPER Tubes ..	lb 3s 5¾d
Sheet	ton £430 5s 0d
H.C. wire and strip ..	ton £407 5s 0d
LEAD, English	ton £104 5s 0d
Foreign	ton £103 0s 0d
MERCURY	flask £109 10s 0d
TIN, block (English) ..	ton £714 0s 0d
ZINC, G.O.B. Foreign	ton £88 15s 0d
Electrolytic	ton £99 10s 0d
BRASS Tubes (solid drawn)	lb 2s 8¼d
Sheet	ton £335 15s 0d
Wire	lb 3s 3¾d
PHOSPHOR BRONZE Wire	lb 4s 11½d
PLATINUM	oz £29 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 25¾d—26d

Electronics for Commerce

Recent developments in the electronic control of factory machinery have profound implications for the future operations of industry and commerce. This is the conclusion



B.T.H. Class QF351 6·6 kV 150 MVA switchboard for the Bombay refinery sub-station

of a special committee set up by the Institute of Cost and Works Accountants, whose first report was published on 1st April. The report envisages the growing use of automatic electronic calculating machines in business and commerce. The report warns cost accountants, however, that the building of a really effective electronic computer for business purposes will not be possible until managers understand its potential qualities and have made up their minds how they want to use it. Many small firms would not be able to afford an electronic computer and the committee suggests hiring computer facilities from service bureaux as a possible solution.

Works Managers' Conference

The national conference of the Institution of Works Managers was held last week at the Conference Hall, Earls Court, London. The theme was "Maintaining Prosperity by Efficient Management." The conference marked the inauguration of the Industrial Engineering Division, and matters dealt with included a discussion on the report of the industrial engineering team of the Anglo-American Council on Productivity, and an address by Mr. W. J. Worsdale on "The Contribution of Industrial Engineering to Works Management."

Trade Mark Fees

As from 1st April higher renewal fees are being charged for trade mark registrations due to expire after 30th June next, and from the latter date there will be a general increase in the fees payable in respect of a number of trade mark matters. The Board of Trade has laid before Parliament revised rules which amend those made under the Trade Marks Act, 1938.

Bombay Refinery

For the new Bombay refinery of Burmah-Shell Refineries, Ltd., officially opened on 17th March, the British Thomson-Houston Co., Ltd., supplied a large proportion of the electrical plant and equipment. In addition to the main and distribution switchgear, 114 B.T.H. motors totalling 2,857 h.p. were installed, most of them totally enclosed, fan-cooled machines for service in dangerous atmospheres. A 5-panel horizontal-plugging, 22 kV, 500 MVA switchboard with associated control and relay panels was supplied, together with a 20-panel, 250 MVA, 6·6 kV board for distribution to the refinery substations. Seven 150 MVA, 6·6 kV panels totalling 80 units were provided for these substations.

Australian Winder Order

The General Electric Co., Ltd., has received an order through its Australian subsidiary, the British General Electric Company Pty., Ltd., for an electric winder equipment for Cessnock Collieries, Ltd., Australia. The equipment to be supplied includes a single drum winder 14ft in diameter designed for an output of 248 tons per hour winding from a depth of 1,227ft. The winder is fitted with single deck cages giving a net load per wind of 3·4 tons of coal. The drum is driven by a 1,450 h.p. direct-coupled d.c. motor with Ward-Leonard control. The reduction gear and brake gear will be supplied by the Erith Works. The remainder of the mechanical parts will be manufactured in Australia from design data supplied from Erith. The motor and control gear will be manufactured at the Witton Engineering Works of the G.E.C. The control scheme incorporates G.E.C. control exciters operating in conjunction with a 1,000 h.p. Ward-Leonard Ilgner set, and the order, which includes the associated a.c. and d.c. switchgear and control desk, is valued at some £A100,000.

British Exhibition, Copenhagen

More than 500 British companies will be represented at the British Exhibition to be held at Copenhagen from 29th September to 16th October next. The exhibition is sponsored jointly by the British Import Union of Denmark and the Federation of British Industries, and is being organized by the F.B.I.'s subsidiary, British Overseas Fairs, Ltd. The total amount of space occupied by stands will be about 125,000 sq ft—divided between the Forum and the Tivoli Gardens. The seventeen sections will include engineering; scientific and optical instruments and photographic equipment; plastics; electrical appliances; radio, television and telecommunication equipment; and refrigerators and food machinery. These will be in the Forum.

Silicone-Coated Fluorescent Lamps

The Electric Lamp Manufacturers' Association informs us that the new silicone-coated fluorescent lamp (type MCFE/U) is available from all its members. It will be sold at 6d (list price) less than the normal instant-start lamp.

Institute of Welding

The annual spring meeting of the Institute of Welding is being held this year in the East Midlands area (28th-30th April) and will comprise a number of works visits and technical sessions. Application for enrolment should be made to the secretary of the Institute, 2, Buckingham Palace Gardens, London, S.W.1.

Radiator Showcard

A striking red, white, yellow and black showcard for its oil-filled electric safety radiators has been produced by Hurseal, Ltd. The cardboard cut-out support at the back has been designed

New Hurseal oil-filled radiator showcard

to fit on to both column and panel radiators. The Hurseal trade mark is a prominent white on red against a black background. Segments of concentric circles in red on black form a background to the sales message. The card is also suitable for counter or floor use.

Philips Marketing Arrangements

Philips Electrical, Ltd., has formed a London and Home Counties Region which will be concerned with the marketing of all products of the company. It comprises the south eastern section of the country, bounded roughly in the north by the Wash, by the Oxfordshire/Worcestershire border in the north west and in the south west by Southampton. The

area also includes the Isle of Wight and the Channel Islands. Mr. H. M. Thorne, formerly radio and television sales manager, has been appointed general regional manager of the London and Home Counties Region, Mr. S. Poole has been appointed regional manager of the lighting and electrical appliances division, and Mr. I. O. Morton has been appointed regional manager of the radio and television division. The headquarters of the new region are at Great Queen Street, London, W.C.2.

Stockholders' Works Visit

The Metropolitan-Vickers works at Trafford Park, Manchester, has been selected by Associated Electrical Industries, Ltd., for an "open house" for a party of stockholders. On 3rd May a party of 200 stockholders will visit the works and two days later another party will pay a visit to Rugby.

Bryce Electric Construction Co.

With reference to the recent announcement that Hackbridge Cable Holdings, Ltd., had acquired the share capital of Bryce, Ltd., we are asked to state that this does not affect the Bryce Electric Construction Co., Ltd., which has been a constituent of Hackbridge Cable Holdings from its incorporation in 1948.

Merchandising Units

The Thompson & Norris Mfg. Co., Ltd., in collaboration with Leon Goodman Displays, Ltd., has recently developed a range of merchandising units made from corrugated fibreboard. These units, which carry striking colour printing, are normally designed as floor stands, thus providing extra counters which are exclusive to a manufacturer's products, and offering self-service facilities if required. Merchandising units are designed to suit the size, weight and nature of the products, and the type of shop in which they will be used. Special coloured and "linen-grain" finish corrugated fibreboard is used in the construction of these units. Attractive multi-colour printing by a combination of rubber stereo and silk screen methods links up with package design and Press advertising. The units combine strength with light weight, and fold flat for easy storage and despatch. Leon Goodman Displays, Ltd., 119-125, Whitfield Street, Tottenham Court Road, W.1, have been appointed sole selling agents.

Examples of corrugated fibreboard units developed by the Thompson & Norris Manufacturing Co., in collaboration with Leon Goodman Displays, Ltd.

Sales Managers' Conference

The annual conference of the Incorporated Sales Managers' Association was held last week-end at the Grand Hotel, Eastbourne. The opening address was given at dinner on 1st April by the Rt. Hon. A. R. W. Low, Minister of State, Board of Trade. On the following day the co-ordination of sales and production policies was discussed, and on Monday the reduction of distributive costs and the determination of the right sales cost were considered.

Electrical Equipment Catalogue

A well produced catalogue dealing with a wide range of industrial electrical equipment has just been issued by the British Central Electrical Co., Ltd. In addition to a general index there is a thumb index, on differently coloured leaves, to the twelve fully illustrated sections, including one dealing solely with flame-proof equipment. Bound in royal blue cloth, gold blocked, the 250-page catalogue should provide a useful reference to any engineer's or buyer's library and copies are available, initially in limited quantities, on application to the company's offices at 6 & 8, Rosebery Avenue, London, E.C.1.

Calendar

The 1955-56 calendar of Metropolitan-Vickers Electrical Co., Ltd., bears a portrait of Miss Diana Clarence, the actress, and is a worthy successor to the calendar which has adorned our office during the past year.

Mobile Electric Showrooms for Trinidad

Three caravans equipped as mobile electric showrooms have been delivered to the Trinidad and Tobago Electricity Commission by Berkeley Coachwork, Ltd., Biggleswade. The vans are wired to permit the demonstration of electrical appliances, and are provided with radio telephone communication equipment by Pye Radio, Ltd. Along the full width of the caravan is a counter with a lift-up flap and door. Behind it, at one side, is a built-in unit including a water tank, compartment for switchboards, and a lift-up top with a sink fitted into a Formica top. The caravan embodies, on the off-side, open shelves and compartments. On the near side is another small counter also used for display purposes. The rest of the available floor space will be used for the demonstration of cookers, washing machines and other electrical appliances.

Trade Announcements

Mr. J. A. Holloway has been appointed manager of the Bristol depot of the **Simplex Electric Co., Ltd.**, operating under the general supervision of Mr. R. F. Arnold, area manager. The position of Mr. S. G. Orchard as manager, South West, remains unchanged. Mr. Holloway has previously been manager of the Flameproof Equipment Department at the head office and he is being replaced by Mr. M. J. Deering, who was previously the lighting sales engineer in London. Mr. B. K. Flaxman has been appointed London lighting sales engineer.

Sunvic Controls, Ltd., has appointed Mr. W. F. Dorman as a technical representative in the London and Home Counties area for its scientific and industrial divisions. Mr. F. C. Chaventre will in future be the technical representative in the same area for the process control division. Mr. D. M. Gill is appointed technical representative in the North West England area for the process control division, and Mr. F. N. Yates, 36a, Brownsville Road, Heaton Moor, Stockport, is technical representative in the same area for the scientific and industrial divisions.

Mr. Ian S. Plumtree, 6, Lansdowne Road, Erdington, Birmingham (Erdington 0460), has relinquished his position as technical sales agent for "Diamond H" Switches to take up a similar position for TOK Electrical & Industrial Mechanisms, Ltd., to cover the area operated by the Midlands Electricity Board and the East Midlands Electricity Board.

Atkins, Robertson & Whiteford, Ltd., manufacturers of radio instruments and industrial electronic devices, Glasgow, have opened a London office and showroom at 53, Victoria Street, S.W.1 (telephone: Abbey 4704). Facilities for demonstrations and servicing will be available.

Burton, Griffiths & Co., Ltd., have removed their Leeds office to 8, York Place, Leeds, 1. The telephone number will remain Leeds 34251.

A new packing design and development department has been opened at the Chipping Warden Centre of **Export Packing Service, Ltd.**

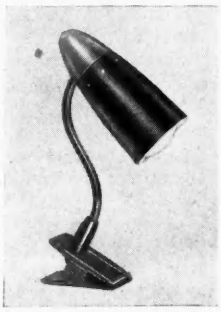
From Monday last the address of **Geo. Becker, Ltd.**, will be 130, Uxbridge Road, Hanwell, London W.7 (telephone: Ealing 4741).

Brook Motors, Ltd., has removed its Swansea Branch to 93, Walter Road, Swansea (telephone: Swansea 57559).

NEW ELECTRICAL EQUIPMENT

All-Purpose Lamp

The "Klippa" all-purpose lamp now being manufactured by DUNCAN, PARTNERS & PRICE, LTD., 55, Uxbridge Road, London, W.12, comprises a ventilated spun aluminium shade reflector mounted on a chromium plated flexible arm, to which is attached



"Klippa" all-purpose lamp

a steel spring clip. It is designed to be clipped anywhere for temporary or permanent use and can also be hung on the wall by means of a keyhole slot contained in the clip. The appliance houses up to a 40 W lamp and is suitable for mains voltages. The clips and dome are finished in grey, and the reflector can be obtained in a range of colours, or all cream. The price is 17s 6d, plus 2s 11d purchase tax in the United Kingdom. A desk lamp, mounted on a moulded block base in the form of an ash tray, with push button switch, is also available, price £1, plus 3s 4d purchase tax.

Transistor Hearing Aid

A hearing aid incorporating transistors has been developed by OSSICAIDE HEARING AIDS, Suffolk Hall, 1, Upper Richmond Road, S.W.15. The new aid (model T.50) is one of the first all-transistor types to come on the market. The use of transistors has made possible a considerable reduction in size: the aid measures only 3⅝in by 1½in by ¾in and its weight is 2½ oz. To this has been allied an improvement in quality, a two-positional tone control giving selective hearing and a full range volume control. Its only battery, a low tension one, lasts two months.

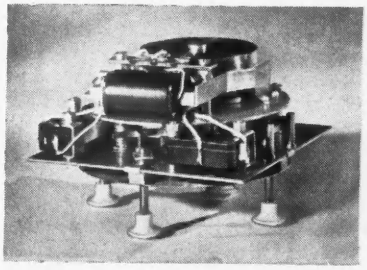
The model T.50 also incorporates the new "M" type receiver, which is less than half the size of a normal hearing aid receiver and is almost invisible when worn. It is supplied with soft plastic pips and detachable cord.

"Ossicaide" transistor hearing aid

The "Pushlite" illuminated bell-push

Radio Switching Clock

An electric clock which will automatically switch on the power supply to a radio receiver (or any other device consuming up to 5 A), at any predetermined time, is now being made by the STIRLING INSTRUMENT CO., LTD., Boden Works, Chard, Somerset. An



Radio switching clock mechanism

alarm buzzer is included which can, if desired, be set to switch on ten minutes after the receiver. Alternatively, the buzzer can be set to switch on at the predetermined time without the receiver. Both receiver and buzzer are automatically switched off after two hours.

Another facility permits the receiver to be switched on immediately for any desired period up to 60 min, at the end of which it is automatically switched off. (The receiver can be switched off manually before the end of this period if required.) The clock is provided with an escutcheon and protecting glass which is incorporated in the receiver cabinet and which is embossed with the clock hour scale. The dimensions of the clock are 3½in high by 3½in wide by 1¾in deep from the dial, and it weighs 15 oz. It operates from 200/250 V 50 c/s mains, the rating at 230 V being 1 W.

Illuminated Bell-Push

V. & E. FRIEDLAND, LTD., Macclesfield, Cheshire, have produced a combined bell-push and nameplate, the "Pushlite." This is an attractive addition to any front door and is particularly useful for those who live in flats. In addition to illuminating the push-button it will, if so placed, throw a beam of light on the keyhole. It also provides a small panel with a card for the name of the owner, house name or number.

The "Pushlite" is made from fluted bronze diaton, and can be used on any transformer-operated bell or chime circuit. It is totally enclosed. The price retail is 7s 6d.

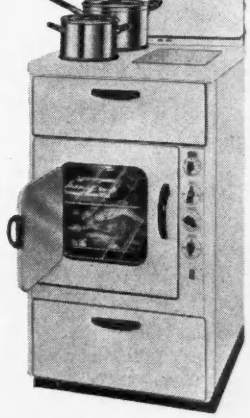
Insulation Tape

In the *Electrical Review* of 25th March (p. 485) a new insulation tape capable of being used in operational temperatures up to 250 deg C was described. We are asked to state that the organization responsible for this product is the Dunlop Rubber Co., Ltd., General Goods Division, Cambridge Street, Manchester.

Glass Oven Door

In response to the demands of trade customers and the public the SIMPLEX ELECTRIC CO., LTD., Creda Works, Blythe Bridge, Staffs, has now included a glass oven door as an extra for the "Creda EV 13" cooker.

The method of fitting the panel ensures that there is no loss of heat,



Creda EV 13" cooker fitted with glass oven door

and that the even heating of the oven is fully maintained. The glass panel with its own auxiliary door is set into the main door, and both are lagged, thereby ensuring a cool front to the cooker.

The price of the "Creda EV 13" cooker with glass oven door and complete with warm drawer is £35 17s.

Silicone-Treated Fluorescent Tubes

Their Use in Instant Start Circuits

By G. D. BRITTAIN, B.Sc.*

INSTANT start circuits for fluorescent lighting installations are achieving a widening popularity as a result of the many advantages which they offer. The elimination of the starter switch, whose life though long, is nevertheless finite, leads to simplified maintenance and greater reliability in operation. In addition, when the tube is operated in instant start circuits, the light output rises smoothly and rapidly to its normal value in a fraction of a second, and the objectionable flickering often associated with switch start circuits is avoided.

In contrast to the " cold start " systems which have been widely used in the United States to achieve instant starting of fluorescent tubes, many lamp and control gear manufacturers in this country recommend the use of circuits in which some means for cathode pre-heating are incorporated. The chief advantages of this are twofold; the starting voltage is considerably reduced, while the less severe demands upon the cathode enable a longer tube life to be achieved.

Control Gear Design

The designer of control gear for instant start circuits is faced with conflicting problems. A higher starting voltage is necessary at low ambient temperatures, and also under conditions of high humidity when a moisture film tends to become deposited on the wall of the tube. To enable standard tubes to be used in instant start circuits, under all conditions, the available starting voltage must be so high that in the more favourable conditions normally encountered, there is a danger of " cold starting," with the attendant risks of cathode disintegration. For this reason it is desirable to design the control gear so that the starting voltage is kept at as low a value as possible. The rise in starting voltage with decreasing ambient temperature is an inherent characteristic of the tube but the effect of humidity on the starting voltage may be rendered negligible by suitable modifications to the tube. One particular modification is the addition of an external earthed metal stripe, which has been widely used to ensure reliable starting under all conditions of humidity.

Silicone Treatment

An alternative approach is to apply a water-repellent coating to the whole surface of the tube, in place of the earthed stripe, and a silicone treatment has now been adopted for tubes to be used under normal conditions in instant start circuits. When used in earthed metal fittings, silicone-treated tubes may be expected to give reliable performance at ambient temperatures down to about 8 deg C and on supply voltages above about 200 V.

The elimination of the metal stripe provides the following advantages:—(1)Special earthing clips are not needed; (2) There is no stripe to conceal, and these tubes may be used in any orientation in the fitting; (3) Silicone-treated tubes may be more easily cleaned than those with an external metal stripe which is liable to damage.

Broadly speaking, the successful operation of fluorescent tubes in instant start circuits depends on the following factors:—

(1) As pointed out above, the available voltage across the tube is intentionally restricted, and is usually insufficient to strike the arc directly between the electrodes. There must, therefore, be an adequate potential difference between the unearthed cathode and the adjacent portions of the tube wall so that local ionization may be set up. This condition is directly achieved if an earthed metal stripe is applied along the length of the tube, and in contact with the outer surface of the glass envelope.

(2) The tube surface must be substantially equipotential. If this condition is not fulfilled, a potential " barrier " can be set up which prevents the discharge from spreading down the tube, unless comparatively high starting voltages are available. It is for this reason that the earthed metal stripe extends throughout the length of the tube and is not confined to the vicinity of the cathodes.

In switch start circuits these factors are not of the same degree of importance, primarily because the instantaneous voltage surge applied across the tube when the starter switch contacts become separated is sufficiently high to strike the arc directly between the heated electrodes.

Effect of a Surface Moisture Film

For tubes not fitted with an external metal stripe, the moisture film which may be deposited on the tube wall under conditions of comparatively high humidity is an

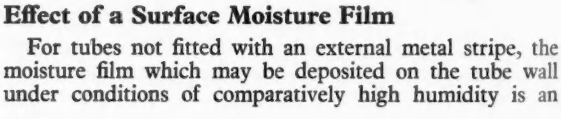


Fig. 1.—A number of conductors, linked by resistors, may represent the distributed surface leakage resistance of a fluorescent tube

important factor in influencing the potential gradient along the tube surface, and hence the starting characteristics. The following simple explanation of the effect of this moisture film on the starting of a fluorescent tube is based on that given by McFarland.†

The distributed resistance of a surface film on the envelope of a fluorescent tube may be represented by a number of closely spaced conducting bands around the tube, adjacent bands being linked by suitable resistors, as shown in Fig. 1. Fig. 2 shows in diagrammatic form the configuration of cathode to tube wall capacitances, leakage resistance, and tube wall to earth capacitances.

In the simplest case of the earthed metal stripe tube the value of r tends to zero, and the value of the capacitances

* The General Electric Co., Ltd.

† " The Cause of the Humidity Effect in Fluorescent Lamps," R. H. McFarland, *Illuminating Engineering*, Vol. XLVI, No. 7, July, 1951 pp. 345–9.

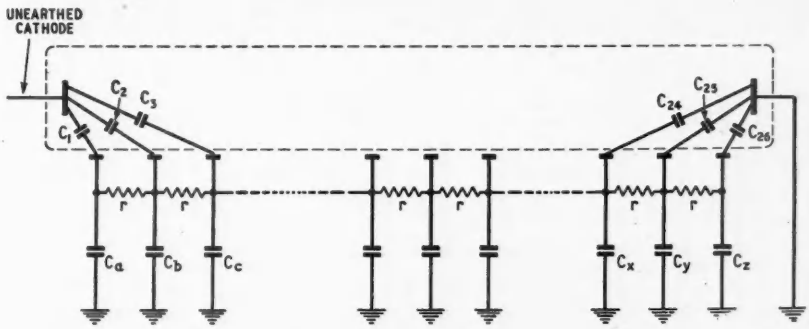


Fig. 2.—Resistance and reactance configuration for a tube with 26 conducting bands connected as shown in Fig. 1

C_a, C_b . . . becomes infinitely large. The full starting voltage is thus applied between the unearthed cathode and the adjacent part of the metal stripe, to give easy initiation of the local discharge. Since the whole of the surface is at earth potential, the discharge extends rapidly down to the tube.

For an unmodified tube, the effect of the moisture film gives a total surface resistance of the order of a few hundred megohms. This leakage resistance can vary over a wide range, depending on the condition of the tube surface. In the equivalent circuit of Fig. 2, where the total surface of the tube has been divided into 26 bands, the values of r will thus be of the order of a few megohms. Fig. 2 has been redrawn in Fig. 3, and the capacitative and surface currents have been included. For a tube with no nearby earthed conductors, the values of C_a, C_b, C_c . . . are negligibly small. C_1, C_2, C_3 . . . are the electrode to tube wall capacitances, and are important only in the areas near the cathodes.

Just before the tube strikes, therefore, the potential drop across each surface resistance element increases as the centre of the tube is approached, as the central elements carry the whole of the capacitative current from electrode to tube wall, while those near the cathodes only carry the local current. Because of these comparatively large potential gradients across the central portions of the tube surface, a correspondingly greater potential must be applied across the tube cathodes to produce the necessary potential difference between the unearthed cathode and the tube wall to excite local ionization. A limit is, of course, set to the voltage necessary across the lamp cathodes by the fact that cathode-to-cathode striking may occur before the onset of local ionization between tube wall and cathode.

With silicone-treated tubes, moisture which tends to be deposited on the tube under conditions of comparatively high humidity is prevented from forming a continuous film. As a result, the leakage resistance across the tube is raised to a very high value, and the effect of this on the ease of starting may be deduced by reference to Fig. 3.

At very high values of surface resistance, r tends to infinity and $i_a \simeq i_1$; $i_b \simeq i_2$ . . . The potential assumed by the tube wall is thus almost entirely controlled by the relative magnitudes of C_1, C_a ; C_2, C_b, etc., and an important factor, therefore, in the successful operation of silicone-treated tubes, is the presence of a capacitance to earth which is large compared with the tube wall to electrode capacitance. In this way an adequate potential difference may be set up between electrode and tube wall to permit the easy initiation of a local discharge. In addition, the presence of a fairly large wall-to-earth capacitance at every point along the tube maintains the whole surface of the glass envelope at nearly earth potential. The silicone treatment therefore gives practically the same potential distribution along the tube as is achieved by the use of an external earthed metal stripe.

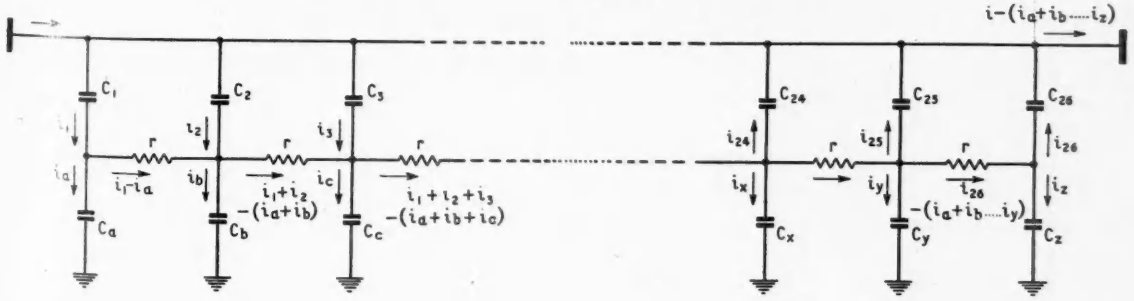
Under normal conditions, the silicone-treated tube may be expected to give reliable performance, provided that it is used in a fitting with the metalwork earthed.

Operation Under Severe Conditions

The ambient temperature has a marked effect on the starting voltage, in view of the change in mercury vapour pressure which accompanies a change in temperature. Under conditions of low ambient temperature, therefore, the available electrode to tube wall potential may be insufficient to provide the potential necessary for ionization, as the total potential will be shared between C_1 and C_a; C_2 and C_b, etc. Similarly, because the full voltage across the lamp electrodes can never be applied between tube wall and the unearthed cathode, operation on a low supply voltage will again reduce the potential that is available for starting.

Preliminary indications show that silicone-treated tubes may be successfully operated in earthed fittings down to about 8 deg C and on supply voltages above 200 V. Instant start tubes with an external metal stripe are being retained for use in installations where the operating conditions may fall outside the broad limits quoted above.

Fig. 3.—Capacitance and surface currents before the arc is struck



Inauguration of New Scottish Board

AT the inauguration luncheon of the South of Scotland Electricity Board in Edinburgh on 1st April, the Rt. Hon. the Earl of Home, P.C., Minister of State for Scotland, proposed the toast "The South of Scotland Electricity Board." He said that the North of Scotland Hydro-Electric Board and the South of Scotland Electricity Board had much scope for enterprise with full employment nowadays. There was no alternative but to increase productivity and there was no better way of doing this than by putting more electrical power at the elbow of the working man. He stressed the need for co-operation between the three authorities, the Central Electricity Authority, the North of Scotland Hydro-Electric Board and the new Board.

In reply Mr. J. S. Pickles, chairman of the South of Scotland Electricity Board, said that the new legislation transferred to the Secretary of State for Scotland all the former responsibilities of the Minister of Fuel and Power. It transferred the assets and obligations of the Central Authority and of the two Boards to a single Board. They would take over a total generating capacity of 1,200 MW. To meet the demand it would be necessary to install more than 100 MW of new plant every year. A new station was being built at Barony and consent had just been given for a very large station at Kincardine. Stations owned by the Board would provide 90 per cent of the Board's present requirements.

The toast of "Our Guests" was proposed by Sir Norman Duke, deputy chairman, South of Scotland Electricity Board, to which Lord Citrine, chairman, Central Electricity Authority, replied. Lord Citrine said it was significant that we had got through one of our hardest winters with no load shedding. Among the nineteen power stations transferred to the Board was Portobello which, for the last two years, had headed the list as the most efficient generating station in the country.

The new Kincardine generating station which was referred to by Mr. Pickles will occupy a site immediately to the west of Kincardine on the north bank of the River Forth. The site will be laid out to accommodate not only the generating station, but also 275 kV and 132 kV transforming and switching stations. The station will be constructed in two sections, each containing three 120,000 kW turbo-alternators, the first section being designed for completion during 1960. Each turbine will be supplied from a unit boiler capable of supplying 860,000 lb/hr of steam at 1,500 lb/sq in and 1,000 deg F. The cooling water for condensing purposes will be taken from the Forth estuary and will circulate through condensers at a rate of 24 million gal per hour when all six sets are in commission.

The station will consume about 2 million tons of coal a year and will have a storage capacity of 450,000 tons. The new generators will be exceeded in size only by the 200,000 kW set recently ordered by the Central Electricity Authority for a station which will be situated on the River Trent in England. The Kincardine station will be the largest and most efficient in Scotland and will be operated mainly as a base load station.

Production and Exports

PROSPEROUS conditions existed in this country last year, production continuing to expand and living standards to rise. The "Economic Survey, 1955" published last week (H.M. Stationery Office, 1s 6d) also shows that in overseas trade and payments the United Kingdom again earned a substantial surplus on current account in the year as a whole; if defence aid is excluded, the surplus was about the same as in 1953. Wages and profits went up by 7½ per cent, and the earnings of the self-employed by 5 per cent, while the prices of consumer goods rose only by about 2 per cent. Most of the extra spending was on household goods (10 per cent). For the future, the compilers of the Survey consider that, provided that there is no serious and persistent adverse trend in the terms of trade, there is every prospect that more of our resources can be used for improving living standards still further after meeting the essential needs of exports and investment. A warning is again given, however, that the rate of progress will depend on how fast we expand our productive capacity and raise productivity.

The main objective, the Survey says, is "to ensure that, while the level of purchasing power is not so high as to interfere with the growth of exports or to attract a larger volume of imports than the nation can afford, adequate incentives are provided for long-run expansion." This, it says, involves the maintenance of full employment for the kind of economic climate which is stimulating to industrial development and research and encourages a dynamic and go-ahead attitude in industry. Costs and prices must be kept stable. The relationship between wages in different occupations and industries must be kept flexible to allow for adjustments in the pattern of production to meet changes in demand.

In general, it will be impossible to keep up a steady rate of expansion without higher imports and these must be matched by higher overseas earnings. The necessary increase in exports cannot be achieved unless British industry is fully competitive but a great deal will also depend on the rate at which foreign markets are growing and the rate at which supplies of the commodities we import are being developed. For this reason we need a world economy in which trade and production expand steadily and trade can flow freely. If the terms of trade move against the United Kingdom it may involve a temporary limitation of the increase in home demand in order that more resources can be diverted to meeting export orders. "But the economy should be able to adapt itself to moderate fluctuations in the terms of trade without serious internal repercussions," says the Survey.

The immediate outlook for world trade is regarded as "reasonably favourable." Industrial production in Western Europe is still rising and the high level of activity is reflected in the buoyancy of trade within Europe.

The upward trend of investment continues in the basic industries and further increases estimated at about £75 million are expected in coal mining, electricity, gas, transport and the Post Office services. Two sectors of industry likely to be fully extended in 1955 are building and engineering. The engineering industries are no longer being called upon to meet additional defence claims, but there is a strong demand at home and abroad for most types of capital goods, motors cars and metal consumer goods.

Castle Donington Power Station

Plans for Six 100 MW Sets with Unit Boilers

IN a paper presented before the Society of Engineers on 4th April, Mr. J. T. Edwards (Central Electricity Authority) gave an account of the civil engineering works (estimated to cost £7,280,000) at Castle Donington power station now under construction on the River Trent in Derbyshire. The site measures 114 acres, of which the coal store occupies 75 acres and the buildings 9 acres, and lies about 3ft below maximum river level. The main plant will consist of six 100 MW generating sets arranged on the unit system; i.e., one boiler rated at 830,000 lb/hr at 1,600 lb/sq in and 1,060 deg F serves one turbine without steam interconnection with the others. Turbine steam conditions are 1,500 lb/sq in and 1,000 deg F.

Because of the high steam temperature all boiler tubes and components are hung from the main steel framework of the boiler house. The 125 MVA alternators are wound for 13·8 kV and the outputs of three of them are transformed to 132 kV and of the other three to 275 kV.

There is a good rail connection from the East Midlands coalfields to six empty-wagon and six full-wagon exchange sidings (to be increased to twelve of each later), from which the station steam and diesel locomotives convey the coal to a reinforced concrete wagon tippler pit; four tracks are provided with tipplers. Two belt conveyors run in a reinforced concrete inclined tunnel from the pit to four steel towers, each 35ft square, on the surface. At the coal store are two stocking-out and one recovery belt conveyors, straddled by an aeroplane belt tripper and a recovery grab transporter. At the extreme end of the track is a short conveyor at right angles, which brings the coal from an underground reinforced concrete recovery hopper into which it is fed by bulldozers with scraper attachments.

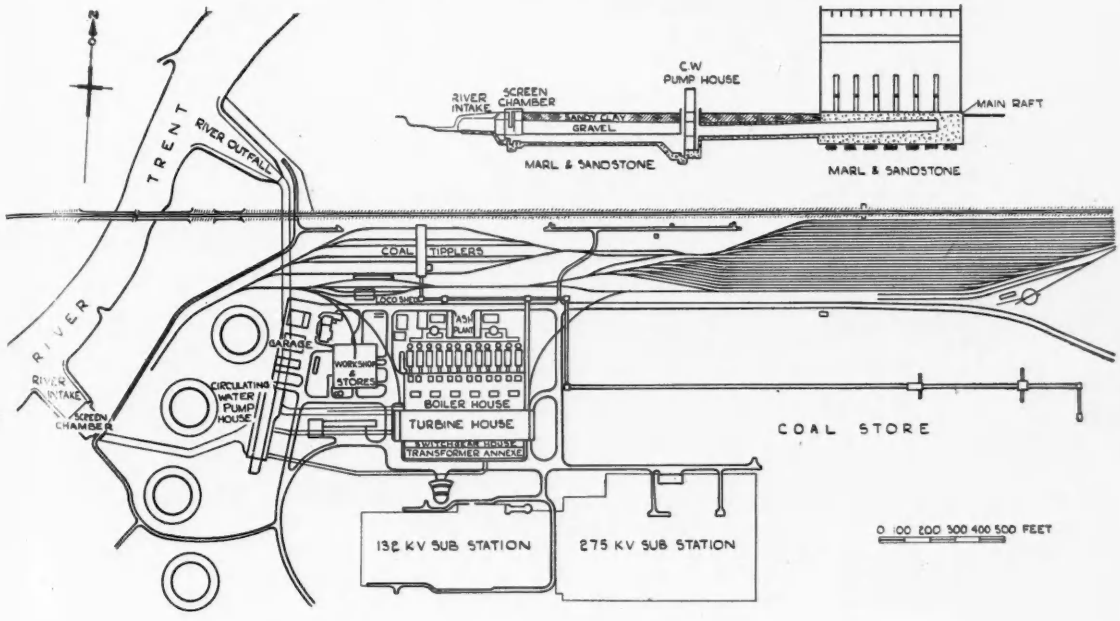
Ashes and dust (1,000 tons a day) will be sluiced by water jets to a central sump, from which the coarse ash will be removed by an overhead gantry grab and deposited in six 10-ton lorries. Fine dust will be sucked away as slurry and pumped through four cast-iron pipes to gravel pits two miles away. The two reinforced concrete chimneys are 425ft high and 23ft in minimum internal diameter and have two flue entries each at 32ft above ground level. They are lined throughout with 4½in heat- and acid-resisting bricks.

Each turbo-alternator is seated on a concrete structure 30ft above the basement floor, the main foundations for which form one wing of a central raft of 24,000 cu yd of colloidal concrete ("Colcrete"), which is 580ft long by 80ft wide by 17ft 6in. The six turbines take a further 17,000 cu yd between them. Experience with colloidal concrete in this country is limited, but its use has saved a considerable amount of time. On account of subsoil conditions, bored piles (900 in all, 19in in diameter and 25ft long) have been driven 10ft into the marl. Passing through the foundation block of each turbo-alternator is a 9ft 6in circulating-water duct from which two 4ft branches lead to the condensers.

About 25 million gal/hr or 1,100 cusecs of water are required for the condensers when all six sets are running, but as the normal flow of the river is 1,000 cusecs in summer and 2,000 to 3,000 cusecs in winter, with extremes of 350 and 20,000 cusecs, four cooling towers, each with a duty of 4·5 million gal/hr, 210ft in diameter and 300ft high have been provided.

Six 70,000 g.p.m. horizontal centrifugal pumps driven by 1,030 h.p. motors supply the river water to the condensers. Four similar pumps deal with the water to the cooling towers from the condenser discharge seal pit, but owing to the greater head the motors are of 1,600 h.p. Water for boiler feed make up and general purposes

Layout of the 600 MW generating station now under construction at Castle Donington, Derbyshire



(350,000 gal/day) is obtained from the gravel stratum below the surface clay.

The main structural framework of the boiler house and turbine house is steel with welded box sections for the principal columns. The boilers are entirely suspended from the steel framework, which includes a plate girder 12ft 6½in deep by 52ft span weighing 32 tons; this girder was delivered in one section by road. The walls of the station building up to 5ft above the operating floor, which is 30ft above ground level, are of concrete and are continued upwards with an asbestos cement sheeting especially developed by Turners for this station.

Alongside the turbine and boiler houses are electrical annexes; each boiler has a separate annexe. The control room is horse-shoe shaped in plan and is lighted from the ceiling through glazing between steel roof trusses. The lighting is diffused through a louvre, above which are mounted fluorescent lamp fittings. Winter heating is by hot-water coils in the floor which are fed from an oil-fired boiler; summer heating is electrical. The high-voltage switchgear is in a compound of two sections, one for 132 kV and the other for 275 kV. The supporting structures, of which there are 450 up to 43ft high, are of reinforced concrete, pre-cast on site. Each compound has a plant house containing relay rooms, air compressors and oil pumps.

The consulting engineers are Freeman, Fox & Partners, and the consulting architects Clifford, Tee & Gale. The civil engineering contractors are given as: William Moss & Sons, Ltd., preliminary works; Taylor Woodrow Construction, Ltd., foundations and superstructure of main and subsidiary buildings, chimney, cooling towers and precipitator foundations and switch compound; The Cementation Co., Ltd., sub-contractor to Taylor Woodrow Construction, Ltd., for colcrete and *in situ* concrete piling; Sir W. Arrol & Co., Ltd., main structural steelwork; J. L. Kier & Co., Ltd., chimney superstructures; the Mitchell Construction, Ltd., cooling tower superstructures; Bierrum & Partners, reinforced concrete precipitator casings.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Distributors and Chain Stores

FROM some of the reports published covering my speech at the annual dinner of the Electrical Wholesalers' Federation it is evident than an entirely wrong impression has been conveyed.

My concluding remarks on the chain stores problem in reference to the possibility of associated distributors refusing to handle products supplied to chain stores lacks clarity. This question of the withdrawal of support should have had reference only to those instances where the terms granted by any manufacturer were excessive and unfair and therefore to the detriment of the distributing section of the electrical industry.

In my earlier remarks I stated that chain stores had come to stay and, therefore, a measure of control was necessary. The industry is only concerned that these groups shall operate in a normal manner with fair competition. No possible exception could be taken to their operation as retailers.

In the interests of all, and not excluding the chain stores, the present pattern of distribution must not be wrecked.

London, W.C.1. W. CRISP,
Immediate Past-President,
Electrical Wholesalers' Federation.

Reversed Polarity

I SHOULD be very grateful indeed if any of your readers would be good enough to advise me on the very vexed question of the dangers—particularly to children—of "reversed polarity," mainly in regard to domestic switch-socket outlets being wrongly connected. There have been many reports in the national Press, in the past, of young children losing their lives through this insidious state of affairs.

In view of the fact that s.p. switch-socket outlets have been and are still being widely used I am wondering whether or not there is a ruling which insists that the neutral should not be switched. The sensible safeguard is, of course, the installation of the d.p. switch-socket outlet or the 13 A socket outlet. I am sure the majority of the public do not understand the danger to life of the expression "reversed polarity."

I have given a great deal of thought to the design of a domestic s.p. switch socket which would be immune from the hazards of "reversed polarity." If the foregoing is correct, however, in my view manufacturers should be encouraged to produce d.p. rather than s.p. switch-socket outlets. There is after all very little difference in the price, and I would leave no stone unturned if something could be done.

If only one child's life were protected, in the future, it would be well worth the endeavour.

Enfield, Middlesex. LESLIE H. FENN.

BOOKS RECEIVED

Interior Electric Wiring and Estimating. Part. II. Industrial. By Kennard C. Graham. Pp. 324; figs. The Technical Press, Ltd., 1, Justice Walk, Lawrence Street, London, S.W.3. Price 40s.

How to Read Electrical Blueprints. By Gilbert M. Heine and Carl H. Dunlap. Revised by C. S. Jones. Pp. 324; figs. The Technical Press, Ltd. Price 38s.

Newnes Electrical Pocket Book. Edited by E. Molloy. Pp. 311; figs. 24. George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2. Price 8s 6d.

Radar Pocket Book. By R. S. H. Boulding. Pp. 176; figs. George Newnes, Ltd. Price 15s.

Electric System Operation. Edited by Bernhardt G. A. Skrotzki. Contributors: W. C. Astley, M. J. Steinberg, E. L. Michelson and E. R. Paige. Pp. 370; figs. McGraw-Hill Publishing Co., Ltd., 95, Farringdon Street, London, E.C.4. Price 49s in the United Kingdom.

Lamps for a Brighter America. By Paul W. Keating. Pp. 246; figs. McGraw-Hill Publishing Co., Ltd. Price 30s.

Training Managers in the Public Services. By F. Bray, R. H. Locke, F. B. Hindmarsh, J. MacDonald, D. Cleghorn Thomson, R. E. Griffiths, A. C. Stuart-Clark and Col. L. F. Urwick. Pp. 84. George Allen & Unwin, Ltd., Ruskin House, 40, Museum Street, London, W.C.1.

WORLD ELECTRICAL MARKETS

Undeveloped Paraguay

By ING. GASTAVO VALLÓ

THE supply of electricity to relatively large townships in Paraguay with from 4,000 to 10,000 inhabitants began shortly after the first world war. At that time electricity was already available in the three largest cities: that is to say in Asunción, the capital, in Encarnación and in Villarica. In Asunción the power and traction undertaking was owned by an Argentine company and was nationalized in 1947. The supplies in the other cities mentioned gradually stopped owing to the failure of the suppliers to maintain their plants, and these places now have no electricity supply. The people living there would, of course, be glad to have it again if the financial and political difficulties could be got over.

The Government is morally supporting the efforts of some other towns and villages to establish electric power stations with internal combustion engines, but most of them cannot afford to provide them. The large private enterprises have their own generating plant and some of them supply electricity to the town or village in which they are situated; but such supplies are at best irregular and depend on the whim of the management.

Minor producers, cattle-raisers and farmers have small sets rated at up to 10 or 20 kW. The only town outside the capital where there is anything like a proper power station is San Bernardino, about 30 miles from Asunción. The plant is of German make, with a M.A.N. engine and an A.E.G. generator. The enterprise is soundly managed and is developing well.

Scope for Small Sets

So far as I know, nobody at the moment has any large-scale financial plans for dealing with the situation; but I do think that it ought to be possible to expand sales of small sets up to, say, 30 kVA. The 10 kVA size should also sell well provided that the price is right. There would have to be a maintenance service established and any British firm selling such sets would need an office here to advise users and look after their plants. It should be possible to sell a hundred 10 kVA sets a year if imports are allowed. Reasonable periods for payment and other facilities would have to be granted.

The electricity supply position in Asunción is gradually improving. The supplying authority, known as "ANDE," has put in new turbines bought in Switzerland from Brown Boveri and this has increased the capacity by about 15,000 kVA. The modernization of the plant and extension of the grid were in full swing until March, 1954, when the Government adopted a new financial policy and halved the exchange value of Paraguayan currency. Thus foreign exchange cost 100 per cent more and ANDE's budget, based on the old rate, could no longer carry the equipment needed for extending the grid. This position will change this year as ANDE is raising the price of its electricity supply, tramway and omnibus services in proportion to the cost of exchange.

In 1950 the Paraguayan Engineers' Association (Centro de los Ingenieros Paraguayos) began work on plans for a hydro-electric power station on the Upper Paraná 150 miles from Asunción. The Paraná is the river which forms the frontier between Paraguay and Brazil. The idea is to use the rivers Acaray and Monday to produce some 100,000 kVA and to sell the power to Brazil. The Brazilians are quite keen to buy this power so as to supply the neighbouring part of their country and there have been talks and preliminary planning. At present an unofficial group of Paraguayans and Brazilians is looking into problems of exploration, mapping and hydrography. Fortunately the location of the two rivers and the Paraná will permit the irrigation of about 375,000 acres of virgin soil suitable for the agricultural development which is planned as a new source of wealth for Paraguay. As yet no final plan has been settled, although various German and French firms have shown signs of being interested in providing equipment. Once this large plant is set up, new roads and new factories will be built near it and the farmers will increase their production. But that is some way ahead.

Reliance on Imports

Paraguay's industrial development is gradual and so far there is no electrical equipment industry worth mentioning. The only appliances produced are domestic electric heaters up to 500 W. All other electrical equipment is imported, mostly from Argentina.

Imports of electric generators have been as follows:—1950, 3,500 kW; 1951, 3,200 kW; 1952, 2,900 kW; and 1953, 3,100 kW, about three-quarters being 10 kW or under. Imports of electric motors of up to 3 kW fell from 4,350 in 1950 to 1,140 in 1953; and those of more than 3 kW from 1,350 to 856. These figures include motors up to 75 kW and alternators up to 100 kVA. There is always a demand for small electric motors of up to 2 kW for household use, particularly water pumping. ANDE says it connects 15 houses a day to the supply mains.

Until recently ANDE used imported copper cables from Chile and Germany for extending overhead lines. Two years ago however it started buying aluminium cables for the same purpose, having appreciated the advantages which these offer. So far about 50,000 metres of aluminium cables have been imported from the United Kingdom. If the position of ANDE is restored to normal, its purchases of such cables will go up considerably.

Nearly all wires for indoor use, small switches, wall plugs and the like are imported from Argentina owing to the regulations applied by the Argentine and Paraguayan Governments.

Finally, here are some ideas for increasing sales of electrical equipment in Paraguay:—

1. *Publicity.*—(a) Agents in Paraguay must arouse interest by using the mails, the radio and the Press to spread information about British goods. Brochures for potential buyers must be *in Spanish*; (b) British producers must provide adequate technical data and descriptions *in Spanish* and they must send samples.

2. *Terms of trade.*—Goods must be offered subject to reasonable periods for payment. Deliveries must be quicker, to meet those of the Italians, Germans, French and others. Prices must be cut if they are above those of other countries. Governments must reach agreement on financing larger plants.

If conditions improve in Paraguay and if there is planned selling, it should be possible in the future to raise sales of electrical goods in this country to a worth-while level.

Radio Isotope Instrumentation

TO assist the potential user of radioactive isotopes in the selection of instruments and other allied electronic equipment to suit his special needs, the Scientific Instrument Manufacturers' Association has published a 124-page reference book entitled "Radio Isotope Instrumentation and Accessories." On Wednesday, 30th March, the first copy of this handbook, which has been compiled and edited by Dr. D. Taylor (A.E.R.E., Harwell) and Mr. A. G. Peacock (Mervyn Instruments, Ltd.), was presented by Mr. C. E. T. Cridland, president of S.I.M.A., to Sir John Cockcroft, director of A.E.R.E., Harwell.

The handbook contains technical descriptions and illustrations of the latest products of over 40 leading firms, and details are given of the various detector-elements and associated apparatus used for radioactive assay and radiation monitoring. In addition information is given about availability of special equipment for accessories such as isotope containers, isotope handling apparatus, dry boxes, etc. This country is now the major source of the world's supply of radioactive isotopes as aids to industry, health, agriculture, geology, etc.

In industry, isotopes are finding increasing application in inspection processes. Industrial radiography is much cheaper and allows penetration of iron, steel, and iron castings, welds and assemblies to depths of 8in in the case of steel. Panoramic exposures for simultaneous inspection of large numbers of objects and inspection inside pressure vessels underwater and in other difficult places are possible.

Thickness gauges measure and control the thickness of strip foil or sheet materials, and are used in hot strip rolling mills where it is necessary to control the thickness of steel strips ranging from 0·05in up to 0·30in. It is also possible to inspect to very fine limits the coating of materials, such as the tinning of steel sheets, to an accuracy of ± 2 per cent of tin coating.

Gauges are now available for liquid level measurement and for the control of weight, while the automatic control of chemical processes is made possible by the continuous flow photo-electric absorptiometer. Package monitors inspect for the correct filling of containers after they have been sealed and operate ejection devices if the packets are empty, under- or over-filled, or do not contain the required predetermined number of items, packed in a particular pattern.

There is equipment for the checking of viscous liquids, such as oil, through an external pipe line system; lubrication problems can be solved. The static charge eliminator prevents risks in the paper, plastics and wrapping industries. In hospitals, scintillation counters are used for diagnostic purposes, for the location of brain tumours and for general blood circulation studies. In plastic surgery the decay rate of an isotope injected subcutaneously gives an indication of the activity of circulation in the tissue.

In surveying and prospecting, equipment can be used from an aircraft or motor-car to locate radioactivity sources. The portable rate meter facilitates prospecting for uranium or thorium, geological mapping and the examination of mine workings. Ultra-violet lamps are used in the detection and identification of minerals by their fluorescence.

Transistors

IN a paper delivered before the London Students' Section of the Institution of Electrical Engineers on 28th March Mr. A. V. Bryant deals with the operation and applications of the transistor as an amplifier. Germanium is the most widely used semi-conductor for the purpose but, he said, silicone is receiving attention owing to its improved high-temperature performance.

Voltage is applied between the point contacts of a fine wire whisker pressing on a block of germanium or across the junction between p and n types of germanium. Impurities (a few parts in a million) added to the pure metal during manufacture produce in the n-type crystal a surplus of free electrons on account of the different atomic structure of impurity. Alternatively, an impurity can be added to provide an overall efficiency of electrons causing "holes" in the p-type germanium, which has a net positive charge. Positive voltage is applied to the p end and negative to the n end so that the n material and the holes in the p material are driven into the central transistor region, where they combine and a current flows. The effect is reversed by severing the voltage when no appreciable current flows.

A transistor is constructed by adding an additional whisker to the point-contact type or an additional section of p or n material to the junction type giving it a sandwich sequence of p-n-p or n-p-n. In the first case one point (the emitter) is biased positively to the germanium block (the base) and the other (the collector) is biased negatively. In the junction type the centre section of the sandwich is the base and the emitter and collector are on either side of it. The emitter is biased to be conducting (one milliamp is suitable for the point-contact type) and presents a low impedance to the source. In the collector the bias is reversed, presenting a high impedance to the load. The collector current varies in sympathy with the emitter current; current amplification between the two circuits is from 2 to 4 with the point-contact type and usually from 0·9 to 0·99 with the junction type.

The point-contact resistor has limited application owing to the need to prevent instability owing to the base resistance. Its power handling capacity ranges from 1 mW to 30 mW; it is useful for trigger circuits. Junction transistors now available in this country have a power dissipation which is limited to 12 mW; although they have a higher gain than the point-contact type, their operating frequency range is more limited.

Rural Electrification

AT the University of Nottingham School of Agriculture, Sutton Bonington, the Electrical Development Association held at the beginning of last week a three-day conference on rural electrification. This was presided over by Mr. C. R. King, chairman of the East Midlands Electricity Board, and was attended by about 130 representatives of Electricity Boards in the United Kingdom, together with observers from France and Holland. Speaking on Monday, Mr. King thought that in years to come the average mixed farm of 150 to 300 acres would willingly be paying up to £400 a year for electricity. He was convinced that rural supplies in general would be self-supporting once the early days were over.

Mr. J. D. Ivins, lecturer in agriculture at the University of Nottingham, gave a paper "Farmers—Their Policy" in which he pointed out that such a large proportion of a farmer's costs went on foodstuffs that a drastic reduction in costs with electrification could not be expected. Another paper by Mr. W. J. Guscott, assistant chief commercial officer to the South Western Electricity Board, was on "Load Building in Rural Areas" and this gave some striking examples of annual savings on a farm and home when electricity replaced oil for various purposes.

Two papers on Tuesday morning dealt with electrical aids to milk production. One by Mr. R. Scott, of the University of Nottingham, dealt with "Trends in Milk Cooling Practices," and the other by Mr. P. Wakeford, of the Central Electricity Authority, compared the use of chemicals and steam as alternative sterilizing techniques. In the afternoon Mr. R. M. Gravett, commercial officer, Chester Sub-Area, dealt with farm electrification in Cheshire where considerable development had taken place before the war, as well as after; and Mr. A. W. Gray, of the C.E.A., spoke on "Electricity in Commercial Horticulture," where lighting and heating were the principal uses involved.

On Wednesday, the last day of the conference, a paper on "Farm Wiring Installations" which stressed that the standard of future farm installations should improve as regards safety and reliability, was given by Mr. W. R. Flintoff (agricultural officer, Newbury Sub-Area, Southern Electricity Board).

Electrical Machining

A Review of Russian Developments

FROM A CORRESPONDENT

NUMEROUS articles in the Soviet technical Press and the issue of several publications on the electrical working of metals indicate the keen and growing interest in this technique in the Soviet Union. A fairly comprehensive treatment of the subject is given by Nosov and Bykhov in their book published in 1953; and shorter accounts in booklets by Zakharov, Zolotykh, etc.

Strictly speaking, electrical methods comprise a series of techniques rather than one only, and include electro-sparking, electro-impulse, anodo-mechanical, electro-contact, electro-mechanical, and electrolytic. The action is mainly thermal, sometimes combined with chemical and/or mechanical effects and sometimes one method may be combined with another. By these methods it is possible to achieve effects hitherto accomplished by complicated and expensive machine tools (lathes, milling machines, planers, and others) not only with high dimensional accuracy but also with such surface finish that further finishing operations are eliminated. Heat treatment, too, could be provided in various forms.

The directions in which electrical methods of working metals are particularly applicable include broaching holes (blind or through) of small diameter, such as 0·15 mm and over, more or less automatic, and much cheaper than usual drilling; reconditioning dies, also with considerable saving (30-50 per cent is claimed by Russian writers); "grinding" hard metals or alloys, e.g. metal carbides bonded with cobalt, etc., especially tools made of these materials; cutting these hard metals, e.g. in components of relatively large size; extracting broken tools or bolts or other fixing means. In general it is claimed that output is enlarged, costs lowered, and accuracy and finish of work improved.

For the so-called dimensional electrical working the following conditions are essential, amounting in sum to narrow localization of action in time and space: (a) the energy of the electrical current should be fed to the workpiece as a momentary impulse or of very short duration; (b) the part to be worked should be sufficiently small; and (c) the energy impulses should be fed to "elemental parts" of metal mass or volume to be removed, continuously, and with sufficient frequency. Unless these requirements are satisfied serious difficulties may be encountered.

Contact and Arc Methods

Among the methods of feeding current may be noted firstly, that of contact between tool (electrode) and work surface. Such contact is not complete between the surfaces, but only with surface roughness "micro-peaks," and the heat provided (Q) may be expressed as $Q=0{\cdot}24R_c I^2$ where R_c is contact resistance and I is current. It is found both by calculation and experiment that, owing to the relatively small contact resistance, the heating effect is comparatively small and insufficient for rapid melting of the metal; also close localization is difficult. This type of current feed therefore is used only in conjunction with mechanical working.

In the second case energy is fed through a discharge gap or path, i.e. short arcing. Here the temperatures at the points of micropeak contacts between electrode (tool) and workpiece are very high and may reach 4,000 to 10,000 deg C. With a small diameter arc, and in view of the fact that only one discharge path exists between the reacting surfaces of tool (electrode) and workpiece, the second condition for dimensional working is fulfilled, i.e. concentration of energy at a given point or very small area. Several successive short arc discharges may occur at contiguous points between tool and workpiece. Obviously in such case the form of the working surface of the tool will be reflected (copied) in the latter. Energy feed through a discharge track is now widely used for the dimensional electro-working of metals.

Fulfilment of the first essential condition requires an impulse voltage supply while the third condition requires the same with requisite frequency and controlled rate of feed. For continuous working the voltage must be such as to form a bridge and sustain a steady heating arc. Therefore, as metal is removed there should be compensatory feed of tool or workpiece to make up for erosion at both these electrodes.

Combined Form of Feed

The third form of energy feed is a combined one of contact and arc. In such case the possibility of copying tool form is limited mainly to bodies of rotation due to corresponding movements of tool and workpiece. The role of impulse generator may be played by a mechanical contact breaker; localization of metal removal by suitable contacting of micropeaks; and continuity of operation with efficient removal of metal by proper feed control. Thus, according to the methods of energy supply, electro-working may comprise three groups: (1) purely contact type; (2) discharge gap type—electro-sparking and electro-impulse; and (3) combined anodo-mechanical and electro-contact methods. The sparking and impulse methods of the second group are distinguished by the kind of impulse apparatus used; and in the third group the anodo-mechanical differ from the contact mainly in the kind of current used—the former using d.c. and the latter a.c.; and by the kind of medium employed—waterglass or other electrolyte for the anodo-mechanical and air, water, oil, etc., for the other. Generally it may be said the contact method is inferior to the anodo-mechanical.

These basic principles are discussed in recent articles in the Soviet technical journals, e.g. in *Stanki i Instr.* 1954, 25 (11), 12-17, where the present position and future prospects of development in this new technology are considered and some of the modern Russian machines noted, with special reference to the dimensional working of metals.

Impulse Generators

Both electrical and mechanical impulse generators are dealt with in detail. As to the former, these include a new electro-technique, that of strong impulse currents of low voltage at different frequencies, with new types of impulse generators hitherto hardly available to the electrical industries. Two types may be distinguished with (a) dependent and (b) independent characteristic. The former are distinguished by the fact that frequency, amplitude and duration of impulses depend on the physical condition of the eroding gap, distance between electrodes,

extent of saturation of the gap with products of erosion, and so forth. The Lazarenkos (B. P. and N. I.) were the first to suggest and experiment with "relaxation" or condenser type impulse generators, around which most modern machines are designed.

The earliest machines of this sort were designated RS (1943), followed by RSL (1947—with resistance and inductance in the charging circuit and working on d.c.), and RSLL (1950—similar, but with inductance also in the discharge circuit). There are other modified and more recent models. Among these is pictured the universal electro-spark broaching-copying machine, Model TsITM-Lenkara, 1953. Other illustrations show another series, such as the 4A722 or 1950—universal broaching-copying; and the 4382 model of 1952—also broaching-copying and specially designed for cutting chip-curling grooves in hard alloy (carbide) cutting tools. These are very much more efficient than the earlier RS.

Defects of Dependent Type

Yet this dependent type of impulse generator has various defects, such as: (a) *Low limit of conversion of impulse into continuous current.* Increase of impulse energy and therefore of apparent efficiency leads to shorter pauses between impulses to the point of complete disappearance, so that continuous d.c. is fed to the spark gap and dimensional working ceases. The limiting rate of metal removal attainable with powerful "Unikal" apparatus does not exceed 1,000 mm³/min, with frequencies of 100-300 imp/sec. (b) *Low efficiency (coefficient of useful work).* Conversion of a.c. of industrial frequency into d.c. required for feeding relaxation generators, and the further conversion of this d.c. into an impulse current, involve large energy losses in the rectifiers (20-30 per cent), in ballast resistances (more than 50 per cent), and in the discharge circuit. Losses, too, in the generator itself are unavoidable. (c) *The relation between the values of impulse and frequency and the physical state of the erosion gap.* With changes in the area and depth of working, conditions of removal of gases and eroded particles, irregularities in feed control, etc., there are corresponding marked changes in amplitude, period, and frequency of impulse, that may adversely affect working. (d) *Current irregularities.* Relaxation or condenser generators, owing to presence in the discharge circuit of unavoidable inductance of leads, condensers, etc., develop an impulse-bearing a.c., that is to say, in addition to the true half-wave there is to a less degree also an opposite or reciprocal half-wave, involving reduced stability and extra wear of tool electrode.

The use of the dependent type of generator is therefore likely to be limited to such cases as the broaching of small diameter holes. In recent years a series of impulse generators based on new principles have been designed: in 1950, by the Ministry of Machine Construction; in 1951, by the ENIMS; and in 1952, by the V. I. Lenin Polytechnic Institute at Kharkov. These independent type generators facilitated development of the new electro-impulse method of dimensional working. Their fundamental difference is that the form of the impulse (amplitude and period) and its frequency do not depend on the condition of the erosion gap; and, with a given source of feed, cannot arbitrarily vary, permitting at the same time a wide range of controlled regimes as required.

The magnitude of the impulse current is practically unlimited, so that metal removal in a given time may be considerable. Thus, Model 150, by no means the most powerful, in broaching-copying work can remove 6,000 mm³/min or about six times more than the earlier type (dependent).

A second basic feature is that of providing the most suitable form of impulse current for the purpose intended, including purely unipolar impulses. This means a marked increase in stability and life of the tool (5 to 20 times more), with possibility of still further improvement in this direction.

A third important characteristic is that of a much higher coefficient of useful work. For example, the experimental model, No. 3,000, of ENIMS, has a coefficient of 73 per cent, or three to five times greater than that of the dependent type generator; and here again still further improvements may be anticipated. Power required per unit of dispersed metal is reduced three- to five-fold. Overall dimensions, too, of the complete machines including generators, are appreciably less. The use therefore of this kind of generator is likely to be widely extended in Soviet industry, especially for large or medium work.

Mechanical generation, forming the basis of anodo-mechanical and electro-contact methods, is the simplest way of obtaining the required impulses. It must, however, be regarded as dependent, since the impulse parameters and frequency are closely related not only to mechanical factors such as speed but also here again to the state of the gap-pressure between electrodes, the kind of working fluid used and the extent of its penetration into the gap.

These generators may be either d.c. or a.c., single- or multi-phase. Control of the working regimes is obtained through voltage variation and use of ballast resistances. According to the nature of relative movement (of tool and workpiece) they may be either rotary or oscillating. Rotary are used for grinding, sharpening of cutting tools and cutting off; and the oscillatory for slotting, mortising and the like. Little change has taken place in these devices in recent years, or any appreciable improvement in utilizing the properties of the electrolytes employed.

In regard to the combined form of generator (electrical plus mechanical) it may be observed firstly that the mechanical component is included not so much for the generation of impulses as (a) to ensure traverse by tool of all the working surface forming body of rotation; (b) to facilitate removal of erosion products; and (c) to stabilize the process. Thus the rate of relative movement may be somewhat less in the combined method: a matter of great importance since, in addition to simplifying design, it is possible to undertake operations such as the grinding of components of small diameter at relatively low linear speeds.

From the foregoing it appears that the most promising line of development is with the independent type generator; and one direction for improvement is the provision of still higher frequencies, especially for the finer regimes. Other possibilities are reducing losses and simplifying design both in the electrical and mechanical parts. A whole series of generators should be available for the different sizes and types of machines.

Electric-Analogue Computing

CIRCUITS and techniques of measurement in an electric-analogue differential analyser at repetition rates up to 25,000/sec were described by Dr. D. M. MacKay in a paper presented before the Measurements Section of the Institution of Electrical Engineers on 5th April. A multiplier on the "quarter squares" principle, using biased diodes to control the feedback characteristic of an amplifier, had been developed to give an output that showed negligible phase-shifts at 50 c/s. Three- or four-dimensional systems with adequate frequency response using resistive resolvers were described. The potential information capacity of electronic-analogue computing methods might be a hundred- or a thousand-fold that obtainable by conventional techniques producing single solutions on a two-dimensional display.

Soil Warming in Southern Rhodesia

By J. G. NEVILLE (Salisbury)

Part of one of the frames showing heating wires

IT is perhaps surprising that there appears to be a need for electric soil warming in a country lying within the tropics such as Southern Rhodesia. In Salisbury, the monthly maximum mean temperature is 77 deg F and the monthly minimum mean temperature is 54 deg F, the coldest months being June, July and August, when light frost can be expected on a few occasions. Experimental work, so far undertaken, however, indicates that the main advantage would appear likely to be in the speedy development of a good root system of such woody cuttings as gardenia, bougainvillea and hibiscus, and plants like virginia creeper, etc.

Initially the Southern Rhodesia Forestry Commission was anxious to obtain bottom heat during the months of May, June and July so that trees and shrubs would be ready for planting out when the first rains occurred in early November. With this end in view, two propagating beds out of a total of eight beds were electrified. Each bed is brick built and measures 30ft by 3ft inside. At the bottom of each bed is 2ft of brick rubble for drainage, and precast linings made up of five parts vermiculite (a local product) and one part cement were fitted into the brick frames. The vermiculite has the property of holding moisture but surplus drains through the brick rubble. It was considered that, in this country, a loading of 4 W/sq ft would be sufficient.

As native labour was to work on the beds it was decided to operate the scheme on a low voltage and galvanized heating wire rather than to use mains voltage cables. The transformer could also be manufactured locally. Imported galvanized fencing wire gave the following resistances:—

S.W.G.	Resistance cold per yard	Resistance hot per yard
12	0·035 ohm	0·04 ohm
10	0·025 ohm	0·029 ohm

Therefore a secondary voltage of 24 was decided upon with 150ft of No. 10 s.w.g. wire. The theoretical loading was thus 4·4 W/sq ft although in practice it was found to be 3·55 W because of the increase in the resistance through heating. Each frame was filled with a mixture of vermiculite and sand.

After 24 hours of heating, the temperature of the soil, at a depth of 6in, rose to 80 deg F compared with 63 deg F in a similar unheated bed. When the two beds had reached this maximum temperature, various cuttings were planted in the hot frame and similar cuttings were placed in a corresponding cold frame. Records of plantings and rooting dates have been carefully kept by Mr. G. Cameron, manager of the nursery, and reveal that on 14th January last 132 gardenia cuttings were planted in both the hot and cold frames. By 10th February 102 cuttings from the hot frame had been potted out, whereas there were no signs of root formation on those in the cold frame; some of these cold-frame cuttings, however, were beginning to root by 24th February.

On 10th November, 1954, single red hibiscus cuttings were planted in the usual shelter previously used and none had rooted by 24th February, whereas of 240 planted in the hot frame on 27th January 183 had been potted out by 22nd February. These results give rise to considerable optimism and the results which may be achieved in the winter are looked forward to with interest. Each frame will hold over 4,000 cuttings and the output from the nursery should be increased considerably as a result of this use of electricity.

The electricity consumption has been 10 kWh a day per bed and it has also been shown by experience that the temperature of the electrically-heated frames can be maintained for at least 14 hours after being switched off during the hot days.

Left: Bougainvillea after four weeks in hot frame. Right: Bougainvillea after four weeks in cold frame

Domestic Electrical Equipment

Refrigerators

BROADLY speaking there are two types of refrigerators, compressor and absorption, both of which continue to have their advocates. The former has the advantage of a greater reserve of refrigeration, ability to freeze more quickly and lower electricity consumption, while the absorption model is favoured by some because, being non-mechanical, it is free from noise and vibration, and can be used on either an a.c. or d.c. supply. Many manufacturers of the compressor type combine the motor and compressor in one hermetically sealed unit. This considerably reduces noise and gives many years of trouble-free service.

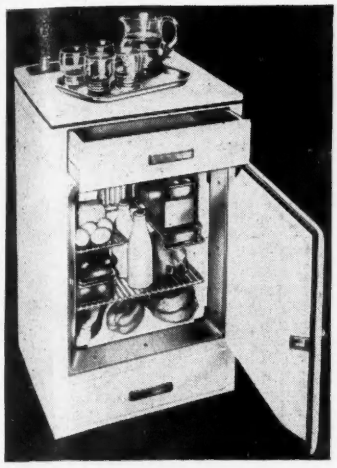
In view of the restricted space in a large number of kitchens the models most in demand are those with a capacity up to about 3½ cu ft. These are fitted with a table top, providing a useful working surface for kitchen needs. The larger, or de-luxe, models are about 5ft in height and have a capacity of 7 to 8 cu ft. Many extra fittings are included, such as butter conditioners, meat keepers, salad crispers, deep-freeze lockers, door shelves, interior lighting, etc.

One of the most noticeable innovations has been the increasing use of coloured finishes. White or cream is still retained for the exterior, although one manufacturer has a range of five colours, but the interiors of several makes are in pale green and blue, thus heightening the impression of coolness. Another maker's range includes a small model finished in polished oak, walnut or mahogany to blend with surrounding furniture when installed in rooms other than the kitchen.

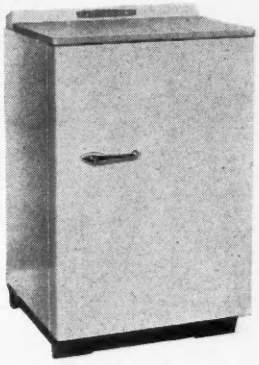
As shown in the following survey the prices, including purchase tax, range between £40 and £55 for the smaller models and from £100 upwards for the de-luxe types. There is an additional charge for installation and servicing, usually between £2 and £4 10s.

Manufacturer	Model	Type	External Dimensions (height, width & depth in inches)	Capacity	Shelf Area	Ice Capacity	Salad Crisper	Frozen Food Chest
ALASKA MANUFACTURING CO., LTD., 73, Clarendon Road, Watford, Herts.	E.70	Absorption	31⅛×20½×25	2·5 cu ft	5 sq ft	40 cubes	—	—
ASTRAL EQUIPMENT, LTD., 96, Buchanan Street, Glasgow, C.1.	BM/A Table	Absorption	26×20½×21½	1·5 cu ft	3·1 sq ft	2 trays (¾ lb ice)	—	—
	BL/A Free Standing	Absorption	36×20½×21½	1·5 cu ft	3·1 sq ft	2 trays (¾ lb ice)	—	—
A. J. BALCOMBE, LTD., 52-58, Tabernacle Street, London, E.C.2.	Crosley Shelvador AMB.7	Compressor	55×24½×25⅜ —	7 cu ft	14·7 sq ft	2 trays	—	Yes (22 lb)
	Crosley Shelvador CAE.8	Compressor	55×24½×27	7·6 cu ft	15·7 sq ft	2 trays	Yes	Yes (28 lb)
	Crosley Shelvador SMG.9	Compressor	57¾×30¾×30½	9·5 cu ft	19·27 sq ft	2 trays	Yes (two)	Yes (50 lb)
	Crosley Shelvador DAE.95	Compressor	56×30¾×30½	9·5 cu ft	20·4 sq ft	2 trays	Yes (two)	Yes (56 lb)
C.S.A. INDUSTRIES, LTD., Wharf Street, Warwick.	"English Rose" ER.50	Dual-Freeze Compressor	36×42×22 3in back ledge	4 cu ft	7·5 sq ft	1½ lb	—	Yes (30 lb)
	"English Rose" ER.92	Compressor	66×21×22	5½ cu ft	10 sq ft	1½ lb	—	Yes
	"English Rose" ER.93	Compressor	36×21×22 3in back ledge	3½ cu ft	6 sq ft	1½ lb	—	Yes
EASICLENE PORCELAIN-ENAMEL (1938), LTD., Darlaston, South Staffs	Easiclene Mk. II	Absorption	37⅝×23½×22	2 cu ft	3·4 sq ft	1½ lb	—	—
ELECTROLUX, LTD., 153-5, Regent Street, London, W.1.	LH.150	Absorption	36×21½×21⅜	1½ cu ft	3½ sq ft	10 cubes	—	—
	L.230	Absorption	36½×21¾×23¾	2½ cu ft	5 sq ft	14 cubes	—	—
	L.500	Absorption	53¼×26¾×27½	5 cu ft	9⅜ sq ft	64 cubes	Yes	Yes
	L.730	Absorption	60×30½×27⅜	7½ cu ft	14 sq ft	80 cubes	Yes	Yes

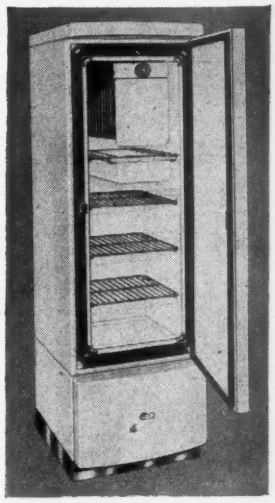
Astral BL/A 1½ cu ft freestanding model



Electrolux LH.150 with drawer



C.S.A. Industries "English Rose" ER.92

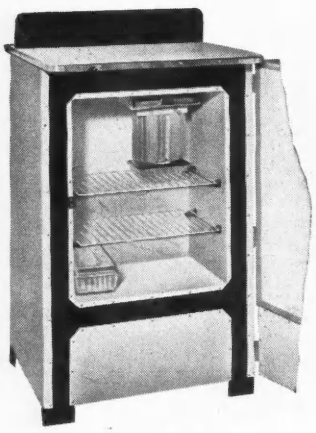


Easiclene Mk. II

Interior Light	Special Features	Motor	Element Loading	Finish	Price (excl. tax)	Purchase Tax
Yes	Plastics table top	—	120 W	All metal cabinet. Vitreous enamelled interior	£34 12 4	£13 1 8
—	Compactness	—	95 W	White stoved enamel	£28 19 2	£10 18 10
—	Compactness. Store cupboard	—	95 W	White stoved enamel	£32 11 9	£12 6 3
Yes	Rust-proof shelves. Meat tray	⅛ h.p.	—	"Dulux" enamel	£90 0 0	£35 2 0
Yes	Rust-proof shelves. Automatic de-frosting	⅛ h.p.	—	"Dulux" enamel	£120 0 0	£46 16 0
Yes	Rust-proof shelves. Two sealed crispers	1/10 h.p.	—	"Dulux" enamel	£135 0 0	£52 13 0
Yes	Rust-proof shelves. Two sealed crispers. Butter safe. Automatic de-frosting	⅛ h.p.	—	"Dulux" enamel	£145 0 0	£56 11 0
—	Designed for zero and normal temperatures	⅛ h.p.	—	Stainless steel or "Formica" worktop. Cream, sea-green or white stoved enamel cabinet	£127 10 0	£49 8 1
—	Four rubber mounted shelves	⅛ h.p.	—	Cream, sea-green or white stoved enamel	£78 0 0	£30 4 6
—	Two rubber mounted shelves	⅛ h.p.	—	Stainless steel or "Formica" worktop. Cream, sea-green or white stoved enamel	£53 0 0	£20 10 9
—	Cabinet top	—	180 W	White stoved synthetic enamel	£38 11 5	£15 8 7
—	Cabinet top. Storage drawer	—	140 W	White stoved enamel. Chromium fittings	£37 6 10	£14 2 2
—	Ice tray with flexible cube releaser	—	140 W	White stoved enamel. Chromium fittings. Plastics inner door panel	£41 18 3	£15 16 9
Yes	Two ice trays with flexible cube releaser. Lockable door handle	—	300 W	White stoved enamel. Chromium fittings. Plastics inner door panel	£81 10 10	£30 16 2
Yes	Two ice trays with flexible cube releaser. Egg and vegetable drawers. Lockable door handle	—	350 W	White stoved enamel. Chromium fittings. Plastics inner door panel	£102 2 5	£38 11 7

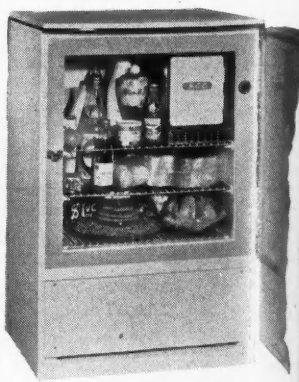
REFRIGERATORS . . . . . *continued*

Manufacturer	Model	Type	External Dimensions (height, width & depth in inches)	Capacity	Shelf Area	Ice Capacity	Salad Crisper	Frozen Food Chest
ENGLISH ELECTRIC CO., LTD., East Lancashire Road, Liverpool, 10.	EA.83	Compressor	57⅜×28⅜×25⅞	8·3 cu ft	14·6 sq ft	28 cubes (3 lb)	Yes (two)	Yes (30 lb)
	EA.34	Compressor	36×22×22	3·4 cu ft	6·4 sq ft	20 cubes (1 lb)	—	Yes (6 lb)
FRIGIDAIRE DIVISION OF GENERAL MOTORS, LTD., Stag Lane, Kingsbury, N.W.9.	AST-43 Standard	Compressor	35×24×25¾	4·3 cu ft	8·2 sq ft	14 cubes	—	Yes (12 lb)
	AMT-43 De-Luxe	Compressor —	35×24×25¾ —	4·3 cu ft	8·5 sq ft	14 cubes	—	Yes (12 lb)
	TST-43 Standard	Compressor	35¾×24×25¾	4·3 cu ft	8·2 sq ft	14 cubes	—	Yes (12 lb)
	TMT-43 De-Luxe	Compressor	35¾×24×25¾	4·3 cu ft	8·5 sq ft	14 cubes	—	Yes (12 lb)
	OMT-79 Standard	Compressor	54½×27½×27½	7·9 cu ft	14·5 sq ft	28 cubes	Yes	Yes (19·2 lb)
	ODT-77 De-Luxe	Compressor	54½×27½×27½	7·7 cu ft	14·9 sq ft	28 cubes	Yes	Yes (45 lb)
	OMT-97 Standard	Compressor	57⅜×31×27½	9·7 cu ft	19·6 sq ft	28 cubes	Yes	Yes (29·4 lb)
	ODT-95 De-Luxe	Compressor	57⅜×31×27½	9·5 cu ft	20·4 sq ft	28 cubes	Yes	Yes (51 lb)
GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.	DE.31	Compressor	36×23×23¾	3·2 cu ft	6·4 sq ft	Ice tray (1·4 lb)	—	—
	DE.52	Compressor	53 11/16×27½×23 1/16	5·6 cu ft	9·1 sq ft	Two ice trays (2·8 lb)	Yes	—
	DE.81	Compressor	55 11/16×27 11/16×28 9/16	8·1 cu ft	15·2 sq ft	Two ice trays (2·8 lb)	Yes (two)	Yes (40 lb)
INSULATIONS & CONSTRUCTIONS, LTD., St. John's Works, Penn, Bucks.	"Cresta" 150	Absorption	23½×23×16⅜	1·5 cu ft	2 sq ft	Ice tray (6 oz)	—	—
	"Cresta" 200 T	Absorption	38½×22½×23	2 cu ft	3·5 sq ft	Two ice trays (15 cubes)	—	—
	"Cresta" 400 FS	Absorption	49×24×23½	4 cu ft	6·5 sq ft	Two ice trays (30 cubes)	Yes	—



Insulations & Constructions "Cresta" 2 cu ft model

G.E.C. DE.81

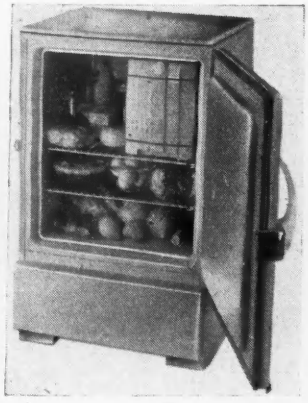


G.E.C. DE.31

Frozen Food Chest	Interior Light	Special Features	Motor	Element Loading	Finish	Price (excl. tax)	Purchase Tax
Yes (30 lb)	Yes	Three door shelves for bottles, canned foods, butter, eggs, etc.	⅛ h.p.	—	White or cream enamelled steel cabinet. Door shelves, control knob, etc., in blue	£100 12 0	£38 0 0
Yes (6 lb)	—	Left or right handed door opening	⅛ h.p.	—	White enamel. Freezer door and storage tray in blue	£48 0 0	£18 3 0
Yes (12 lb)	—	" Meter-Miser " sealed rotary compressor	⅛ h.p.	—	Interior and tabletop— vitreous enamel. Exterior— plastics based synthetic enamel	£48 1 7	£18 3 5
Yes (12 lb)	Yes	" Meter Miser " sealed rotary compressor. Door racks	⅛ h.p.	—	Interior and tabletop— vitreous enamel. Exterior— plastics based synthetic enamel	£51 17 10	£19 12 2
Yes (12 lb)	—	" Meter Miser " sealed rotary compressor	⅛ h.p.	—	Interior and tabletop— vitreous enamel. Exterior— plastics based synthetic enamel	£48 16 10	£18 9 2
Yes (12 lb)	Yes	" Meter Miser " sealed rotary compressor. Door racks	⅛ h.p.	—	Interior and tabletop— vitreous enamel. Exterior— plastics based synthetic enamel	£52 13 1	£19 17 11
Yes (19·2 lb)	Yes	" Meter Miser " compressor. Hydrator and meat tender. Door racks	⅛ h.p.	—	Interior and tabletop— vitreous enamel. Exterior— plastics based synthetic enamel	£83 19 5	£31 14 7
Yes (45 lb)	Yes	" Meter Miser " compressor. Hydrator. Door racks	⅛ h.p.	—	Interior and tabletop— vitreous enamel. Exterior— plastics based synthetic enamel	£95 8 1	£36 0 11
Yes (29·4 lb)	Yes	" Meter Miser " compressor. Two hydrators. Meat tender. Door racks	⅛ h.p.	—	Interior and tabletop— vitreous enamel. Exterior— plastics based synthetic enamel	£112 18 7	£42 13 5
Yes (51 lb)	Yes	" Meter Miser " compressor. Two hydrators. Door racks	⅛ h.p.	—	Interior and tabletop— vitreous enamel. Exterior— plastics based synthetic enamel	£123 12 0	£46 14 0
—	—	Freezer incorporates large compartment for frozen foods	⅛ h.p.	—	White stoved enamel cabinet. Plastic on steel interior	£46 9 0	£17 11 0
—	Yes	Freezer incorporates large compartment for frozen foods	⅛ h.p.	—	White stoved enamel cabinet. Plastic on steel interior	£69 0 0	£26 1 5
Yes (40 lb)	Yes	Freezer incorporates large compartment for frozen foods	⅛ h.p.	—	White stoved enamel cabinet. Plastic on steel interior	£101 18 0	£38 10 0
—	—	Styled to blend with furniture	—	95 W	White enamel, walnut, oak or mahogany	£28 14 1	£11 3 11
—	—	Table worktop	—	110 W	White enamel	£35 15 1	£13 18 11
—	Yes	Meat keeper and egg shelf	—	165 W	White enamel	£54 7 9	£21 4 3

E.31

English Electric EA.83



English Electric EA.34

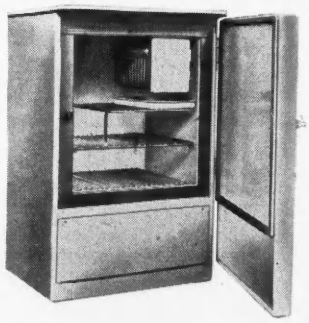
Frigidaire ODT 95

REFRIGERATORS . . . . . *continued*

Lec Refrigeration P.9 model

Lightfoot 7.FLDR De-Luxe

Lightfoot 3.LDR



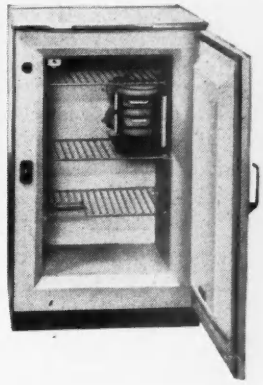
Pilmore TW/3 table top model

Manufacturer	Model	Type	External Dimensions (height, width & depth in inches)	Capacity	Shelf Area	Ice Capacity	Salad Crisper	Frozen Food Chest
INTERNATIONAL REFRIGERATOR CO., LTD., (now COLDRATOR, LTD.), Fletton, Peterborough.	AT.18	Absorption	38½ × 21 × 21	1·5 cu ft	3 sq ft	One ice tray (18 cubes)	—	—
	CT.33	Compressor	36⅞ × 21 × 21	3·3 cu ft	6·1 sq ft	One ice tray (20 cubes)	—	—
	CT.45	Compressor	36½ × 24½ × 25½	4·5 cu ft	8·3 sq ft	Two ice trays (36 cubes)	—	—
	CS.71	Compressor	53½ × 27½ × 24½	7·1 cu ft	13 sq ft	Two ice trays (36 cubes)	Yes (two)	Yes
LEC REFRIGERATION, LTD., Shripney Road, Bognor Regis, Sussex.	P.36	Compressor	41 × 23 × 21¼	3·3 cu ft	4·8 sq ft	6 cubes	—	—
	P.42	Compressor	43 × 23 × 21¼	4·2 cu ft	—	Two ice trays (12 cubes)	—	—
	P.6	Compressor	49¼ × 26¼ × 22 3/16	6·1 cu ft	10·1 sq ft	Two ice trays (24 cubes)	Yes	Yes
	P.9	Compressor	60½ × 29¾ × 23	9·1 cu ft	—	Two ice trays (24 cubes)	Yes	Yes
LIGHTFOOT REFRIGERATION CO., LTD., Abbeydale Road, North Circular Road, Wembley.	3.LDR	Compressor	36 × 23 × 21⅞	3·2 cu ft	6 sq ft	Ice tray (1·4 lb)	—	—
	5.LDR	Compressor	53⅜ × 27½ × 24	5 cu ft	9·4 sq ft	Two ice trays (36 cubes)	Yes	Yes
	7.LDR Standard	Compressor	55 11/16 × 27½ × 24½	7·6 cu ft	12·5 sq ft	Two ice trays (2¾ lb)	Yes	Yes
	7.FLDR De-Luxe	Compressor	55 11/16 × 27½ × 24½	7·6 cu ft	13·4 sq ft	5½ lb	Yes (two)	Yes (Full width)
NASH-KELVINATOR, LTD., Hudson Motors Building, Great West Road, W.4.	"Kelvinator" C.115K	Compressor	36 × 22½ × 21 5/16	3 cu ft	6 sq ft	1½ lb	—	—
	"Kelvinator" C.135K	Compressor	38 25/32 × 24 7/16 × 23 13/16	4 cu ft	6·7 sq ft	1½ lb	—	—
	"Kelvinator" C.225K	Compressor	53½ × 24 × 27 27/32	7·4 cu ft	13 sq ft	Two ice trays (4 lb)	Yes	—
	"Kelvinator" C.245K	Compressor	53½ × 24 × 27 27/32	6·9 cu ft	13·5 sq ft	Three ice trays (6 lb)	Yes	Yes
	"Kelvinator" C.265K	Compressor	53½ × 24 × 27 27/32	6·9 cu ft	13·5 sq ft	Three ice trays (6 lb)	Yes	Yes

Coldrator AT.18

Coldrator CT. 33

Kelvinator C.265K



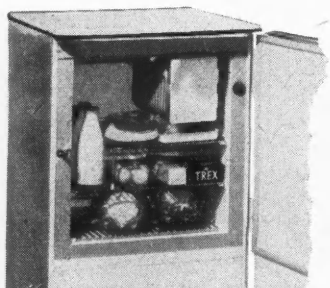
Alaska 2·5 cu ft "E.70"

Interior Light	Special Features	Motor	Element Loading	Finish	Price (excl. tax)	Purchase Tax
—	Table top surface. Trigger door latch	—	100 W	White or cream abrasion resistant enamel	£37 17 9	£13 11 3
—	Plastics table top. Trigger door latch	½ h.p.	—	White or cream abrasion resistant enamel	£51 12 2	£18 14 10
Yes	Armoured plate class table top. "Buttador" compartment	½ h.p.	—	White or cream abrasion resistant enamel	£72 11 10	£26 2 2
Yes	Adjustable feet. "Buttador" compartment. Door shelves	½ h.p.	—	White or cream abrasion resistant enamel	£98 10 1	£35 17 11
—	"Silometic" sealed unit	⅛ h.p.	—	White or cream stoved enamel	£43 15 0	£16 1 9
Yes	"Silometic" sealed unit	⅛ h.p.	—	White or cream stoved enamel	£50 19 0	£18 18 0
Yes	"Silometic" sealed unit	⅛ h.p.	—	White or cream stoved enamel	£83 10 0	£31 4 0
Yes	"Silometic" sealed unit	⅛ h.p.	—	White or cream stoved enamel	£101 0 0	£37 12 8
—	"Tropicalized" for ambient temperatures above 90 deg F	⅛ h.p.	—	White stoved enamel	£46 9 0	£17 11 0
Yes	Meat and fish drawer	⅛ h.p.	—	White stoved enamel	£69 0 0	£26 1 5
Yes	Long door	⅛ h.p.	—	White stoved enamel	£87 10 0	£33 1 2
Yes	Frosted food compartment	⅛ h.p.	—	White stoved enamel	£94 0 0	£35 10 3
—	High speed freezer	⅛ h.p.	—	White stoved enamel cabinet. Ice-blue plastics inner door panel	£49 18 0	£18 2 0
Yes	High speed freezer	⅛ h.p.	—	White stoved enamel cabinet. Ice-blue plastics inner door panel	£60 2 7	£21 15 5
Yes	Meat tray. Door shelves	⅛ h.p.	—	White stoved enamel cabinet. Ice-blue plastics inner door panel	£89 17 6	£32 8 10
Yes	Meat tray. Door shelves. Butter keeper	⅛ h.p.	—	White stoved enamel cabinet. Ice-blue plastics inner door panel	£104 12 2	£38 0 3
Yes	Automatic de-froster. Meat tray. Door shelves. Butter keeper	⅛ h.p.	—	White stoved enamel cabinet. Ice-blue plastics inner door panel	£114 10 4	£41 15 1

REFRIGERATORS . . . . . *continued*

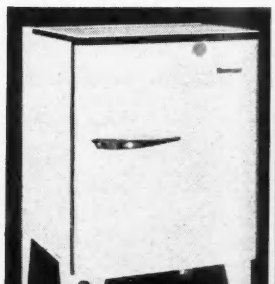
Manufacturer	Model	Type	External Dimensions (height, width & depth in inches)	Capacity	Shelf Area	Ice Capacity	Salad Crisper	Frozen Food Chest
PILMORE REFRIGERATORS (SALES), LTD., 104/106, Bromley Road, London, S.E.6.	TW.3	Compressor	33×32×21	3 cu ft	6½ sq ft	Ice tray (18 cubes)	—	—
	"Consort" IV	Compressor	38×23×21	4 cu ft	6½ sq ft	Ice tray (18 cubes)	—	—
PRESSED STEEL CO., LTD., Cowley, Oxford.	"Prestcold" S.313	Compressor	36×21½×24⅞	3·1 cu ft	6 sq ft	1½ lb	—	Yes (7½ lb)
	"Prestcold" L.52	Compressor	47 5/16×25 5/16×27½	5·5 cu ft	10·2 sq ft	2¾ lb	Yes	Yes (12 lb)
	"Prestcold" L.72	Compressor	51¾×28 1/16×27	7·2 cu ft	11·6 sq ft	3 lb	Yes	Yes (22 lb)
WALLIS REFRIGERATION CO., LTD., Hamworthy, Poole, Dorset.	"Dorset" TM.150	Absorption	32×22×25½	1·5 cu ft	3·3 sq ft	12 cubes	—	—
	"Dorset" TM.225	Absorption	34⅜×23×25½	2·25 cu ft	5·1 sq ft	24 cubes	—	—
WILKINS & MITCHELL, LTD., Darlaston, South Staffs.	"Servis" MSR.33	Compressor	36×23×21⅞	3·3 cu ft	6 sq ft	1½ lb	—	Yes

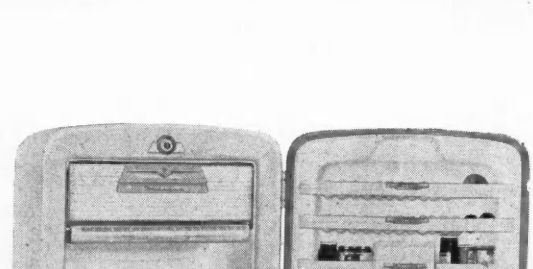
Wilkins & Mitchell "Servis" MSR.33



"Prestcold" L.72

Wallis Refrigeration's "Dorset"





Crosley Shelvador DAE.95

Electrolux L.7[illegible]0

	Frozen Food Chest	Interior Light	Special Features	Motor	Element Loading	Finish	Price (excl. tax)	Purchase Tax
	—	—	Table top. Drop door	⅓ h.p.	—	White vitreous ename	£50 0 0	£19 7 6
	—	—	Table top	⅓ h.p.	—	White vitreous enamel	£53 10 0	£20 14 7
	Yes (7½ lb)	—	Table top	⅓ h.p.	—	White vitreous enamel	£48 11 3	£17 11 9
	Yes (12 lb)	Yes	Two door shelves	⅓ h.p.	—	White vitreous enamel	£76 3 4	£27 13 8
	Yes (22 lb)	Yes	Two door shelves. Meat tray. Butter keeper	⅓ h.p.	—	White vitreous enamel	£91 12 11	£33 6 1
	—	—	Table top	—	100 W	White vitreous enamel cabinet. Stoved enamel interior	£28 14 2	£11 3 10
	—	—	Set plastics containers	—	140 W	White vitreous enamel cabinet. Stoved enamel interior	£36 5 3	£14 2 9
	Yes	—	Table top	⅓ h.p.	—	White stoved enamel	£49 0 0	£18 19 9

Railway Speed Record

Electric Train Travels at 200 m.p.h. in France

THE French Railways 4,000 h.p. electric locomotive BB 9004 hauling a test train composed of three carriages each weighing 34 tons last week reached a world record rail speed of 205 m.p.h. The record-breaking run took place on the line from Bordeaux to Dax, which includes a straight level stretch of 21 miles long between Lamothe and Morcenx. The locomotive weighs only 79 tons. The only modification it received was to the transmission system so as to raise the gear ratio. A higher speed still would certainly have been possible had it not been necessary to limit the speed on the curves at the beginning and the end of the straight stretch to 125 and 75 m.p.h. respectively. To ensure an adequate supply during the run mobile substations connected to the national grid were placed at intervals along the line. As this was electrified as long ago as 1927, the overhead traction wires and their supports received special attention so as to ensure that there should be no difficulty in picking up current during the run. The principal object of this run was to study the behaviour of the locomotive, carriages, track and overhead traction wire equipment when travelling at such high speeds. The same record speed of 200 m.p.h. was reached the previous day under similar conditions by the 4,400 h.p. French railways electric locomotive CC 7107 which however is 27 tons heavier than the BB 9004.

Locomotive BB 9004 is a prototype built in 1953 by the Société de Matériel de Traction Electrique. A simplification of the body construction and the mechanical and electrical equipment has led to a prime cost of £95,000 and a total weight of 79 tons against £180,000 and 138 tons respectively for the 2-D-2's built for the electrification of the Paris-Lyons main line. Furthermore, the BB 9004 has already covered nearly 100,000 miles without giving any mechanical trouble. It is estimated that a mileage of 375,000 will be possible without major overhaul. To instance its performance under normal service conditions, the BB 9004 has covered the 318 miles between Lyons and Paris hauling a train of 874 tons at an average speed of 79·5 m.p.h.—a remarkable performance for a locomotive of this weight on a line with one gradient of 1 in 125. In view of the success of this new design, the French Railways have decided to order nine more of these locomotives for the future electrification of the line between Dijon and Vallorbe. The 4-pole traction motors without compensation built by Schneider-Westinghouse are suspended at the centre of the bogie frames (there are no bogie pivots in the ordinary sense). They transmit their power to the axles by means of a cardan shaft coupled to one of the driving wheels and can be coupled in series-parallel and in parallel. The body is all-welded but the upper side panels and the centre roof sections can be quickly dismantled so as to facilitate inspection and maintenance. The weight of the body is carried on the bogies through a bilateral system of pendulum-type suspension with laminated springs which minimize rolling, and with "anti-nosing" friction bolsters. Tractive effort is transmitted longitudinally to the body through traction drawbars which are mounted underneath the bogies so as to minimize "hunting."

The record breaking French Railways locomotive BB 9004

Financial Section

STOCKS and SHARES

THE end of the first quarter of the year found Stock Exchange markets in chastened and inactive mood, but a good deal firmer than had been the case for much of an unusually disturbed period. In the first part of it, the share price indices had continued to break altitude records even after the authorities fired a first warning shot by raising the Bank Rate from 3 to 3½ per cent, thus calling attention to the signs of deterioration in the country's import-export balance and the gold reserves. Not until the Rate was shot up to 4½ per cent, and accompanied by the reintroduction of hire purchase restrictions, did markets begin to reflect any serious worry. There followed the spectacular plunge of early March, followed by a spell of erratic fluctuation. By the finish of March most prices had recovered their equilibrium at levels well above the worst, but still some way below those ruling a month or two previously.

Highs and Lows

In the following table, the comparison of end of March prices with the highest and lowest recorded since the beginning of the year gives a general idea of the extent of the fluctuations in the case of a representative section of electrical shares. It may be mentioned that although many of the net falls appear substantial, electrical equipment shares as a whole have performed relatively well, thanks in large part to the association of the shares with the railway modernization plans.

Ord. shares	1955 High	1955 Low	End March
A.E.I.	74/3	61/3	66/3
Auto. Tel.	79/6	69/-	70/-
B.I.C.C.	55/3	44/9	48/-
Brush	9/7	7/7	8/6
Chloride El.	69/-	58/6	60/-
E. K. Cole	24/6	18/3	19/6
Cossor	11/3	8/9	9/3
Crompton P. ...	19/9	16 -	16/-
E.M.I....	37/-	25/3	29/6
English Electric ...	69/3	54/-	63/-
Henley's	20/6	17/-	19/6
Hoover	52/6	40/-	44/-
J. & P.	52/6	45/-	45/6
Lucas...	50/6	41/6	42/-
Parsons	69/6	56/-	60/-
Plessey	76/6	57/6	62/6
Pye	40/6	28/6	32/6
Reyrolle	106/3	89/-	92/6
S. Smith	20/-	15/-	16/-
T. C. & M.	40/9	35/-	37/-
Tube Investments ...	85/9	72/6	76/-
Westinghouse ...	102/-	82/-	93/9

Dividends Declared

Pressed Steel 5s shares were quoted higher at 22s 3d after news of the increase in the dividend from a total of 17½ to 22½ per cent. On the new basis, the yield became a fraction over 5 per cent. The excess profits levy had been afflicting previous earnings with particular severity, and the preliminary profits statement indicates that the lightening of the tax burden (although it still amounted to almost £1¾ million) contributed to a 40 per cent expansion in the net group profit of £1,151,000. Allen West's 15 per cent dividend, payable on capital increased by a one-for-two scrip issue, represents an improvement of 3⅓ per cent on last year's distribution. In this case also the provisional figures for the year indicate a smaller tax charge and a corresponding expansion in the net profit at £425,000. The 5s shares rose to 13s, making the yield 5¾ per cent.

A.E.I. Issue

Ordinary stockholders in Associated Electrical Industries were notified at the annual meeting that allotment letters in connection with the issue of new shares are to be posted on 30th April. The intention is to start dealing in them on Monday, 2nd May. As announced previously, the issue involves the offer of just on five million new shares to existing shareholders, on a one-for-four basis, and a further 215,000 to employees of the group, the price in both instances being 40s per share. Payment in full for the new shares will be concluded by 3rd June. They will not be entitled to participate in the first of the quarterly dividends which the company is now inaugurating and which will start with a 2½ per cent payment.

Chloride Electric

Another of the important dividend announcements due this month is that of the Chloride Electrical Storage Company, which produced the results last year in the middle of April. On that occasion, the dividend was raised in effect (allowing for the intervention of a share-for-share scrip issue) from 10 to 12½ per cent. On this basis, and although the price has come back about 9s from this year's peak, the £1 "A" shares at £3 have been showing a yield of not much over 4 per cent, a level betokening confidence in the prospects. Last year's report referred to well-filled order books, and to an increase in sales during the first quarter of the year. Subsequently, the interim dividend was held at 5 per cent on capital doubled by the scrip issue.

Yields of 6¾ Per Cent

Best market expectations were fulfilled by the 10 per cent dividend declared by Aberdare Cables (Holdings). It is announced as a second interim (the first had already been increased) but represents, in fact, the final payment for the year ended last October and makes a total of 17½ per cent, against 12½ per cent last time. No indication of earnings accompanied the statement. After being marked up to 13s, the company's 5s ordinary shares stood on a yield basis of approximately 6¾ per cent. A similar is shown by Newman Industries 2s shares, which were dealt in a little below 3s after the declaration of the single 10 per cent dividend on account of last year. This will be the fourth successive payment at the same rate.

Aluminium and Oxygen

British Aluminium £1 shares reacted well to the restoration of the distribution for 1954 to a total of 12 per cent. Last year the 2 per cent bonus was dropped, leaving a 10 per cent dividend covered by only a narrow margin of earnings, as a result of the difficult trading conditions persisting throughout 1953. This time the profits statement reports a rebound in the net surplus from £410,000 to £734,000, despite an almost trebled tax charge of £1,185,000. Following the news, the price of the shares was marked up from 39s to 42s, at which the yield is just on 5¾ per cent. British Oxygen's earnings continued last year on the upgrade, but the company's decision is to hold the dividend rate at 15 per cent. The price of the £1 shares came back a little to 62s 9d.

Watford Results

Watford Electric & Manufacturing 2s ordinary shares have changed hands around 7s since the declaration of final distributions making a total of 25 per cent for 1954. This includes 10 per cent as bonus, and compares with the last year's total of 22½ per cent, of which 5 per cent was paid before a three-for-five share distribution. Ranking for dividends this time are the 141,000 new ordinary shares issued to shareholders at 4s 3d last October, when new preference shares were also offered. Proceeds of these issues were required to finance factory additions and re-equipment. According to the preliminary profits statement, net profits improved by a third, and the surplus (after tax) in the same proportion, from £36,000 to £48,000. The yield on the shares works out now at 7 per cent.

Owing to the Easter arrangements our usual investments table is omitted this week.

RADIO SYSTEM LINK

An interesting u.h.f. radio link installation has recently been completed by Standard Telephones & Cables, Ltd., for the Compania Telefonica Nacional de Espana. Believed to be the first commercial u.h.f. time-sharing system to link two continents, the installation handles telephone traffic between Europe and North Africa. Spanning the Straits of Gibraltar, one side of the link is installed at Algeciras on the Spanish Atlantic coast, and the other at Ceuta, some 32 km distant, in Spanish North Africa. "Standard" 24-channel time-sharing multiplex equipment, type DP.1, is installed at both sites, together with suitable terminating equipment.

REPORTS and DIVIDENDS

Associated Electrical Industries, Ltd.—The annual meeting was held on 29th March, Viscount Chandos (chairman) presiding. Before dealing with the group's activities during the past year, the chairman referred to the retirements of Sir George Bailey, as chairman, Sir Hugh Warren (managing director), Sir Arthur Fleming, and Mr. Grimsdick and Mr. E. W. Steele (directors). Sir George Bailey remained a director and the group would still have the benefit of the advice of Sir Arthur Fleming and Mr. Grimsdick.

Referring to changes in organization, Viscount Chandos said that the company had been organized into four groups. They were the British Thomson-Houston, Metropolitan-Vickers, Edison Swan and A.E.I. Overseas Groups. Each was headed by a managing director who was also a director of the parent company. They were respectively, Mr. Ball, Dr. Dannatt, Mr. McHaffie and Sir Ivor Cox. The A.E.I. was also in process of rationalizing the manufacture and marketing of the several lamp interests, and for this purpose a new company had been formed called the A.E.I. Lamp & Lighting Co., Ltd., which would be administered by the B.T.H.

After referring to other rearrangements of directorships, the chairman mentioned the company's intention to introduce quarterly dividends and to publish a progress report covering six months' operations.

Turning to the accounts, the chairman said that in 1954 they surpassed the previous record of 1953 both in volume and value. The total output exceeded in value £96 million compared with £86 million for 1953. The profit margins were on the whole well maintained but were slightly lower than they were last year. The total orders received during the year showed a striking increase, but owing to increasing rate of output the total amount of orders on the books, for delivery mainly over the next three years, was approximately £123 million or about 3 per cent less than last year.

Power station plant commissioned during the year included eleven turbo-alternator sets with an aggregate capacity of more than half a million kW. New business received from the C.E.A. included a Metropolitan-Vickers 120 MW turbo-alternator for Blyth power station which would operate at 1,500 lb/sq in and 1,000 deg F, and the fifth 100 MW set for Castle Donington power station; also large quantities of transformers and switchgear for operation on the 132 kV system and 275 kV supergrid. In the industrial field the group as a whole had secured a satisfactory and increased volume of business, in particular for the steel, mining and shipbuilding industries. The demand for domestic appliances had thrown heavy loads on the Hotpoint factories of the Ediswan-Hotpoint group. The value of the output rose by 21 per cent.

In shipping overseas rather more than £28 million worth of equipment, the previous year's record had been exceeded by 8 per cent. Some 370 MVA of waterwheel generators were completed by M-V and B.T.H. for various parts of the world, while the B.T.H. Co. commissioned the first of two 2,500 kW gas turbine alternator sets at the Nairobi South power station, the first British-made gas turbine operating on heavy oil to be commissioned overseas. Other B.T.H. plant included two 15,000 kW waterwheel alternators at the Owen Falls station, Uganda. A provisional order for a further two generators for this station was received during the year.

New export orders received showed a heartening increase of about one-third over the previous year. Among these was a contract worth £7 million secured by M-V for 100 new train units for the Rio de Janeiro suburban services. That same company also obtained a contract for the Eirean railways for 94 diesel-electric locomotives worth in all some £4¾ million. In the Canadian market M-V secured two further major contracts, the first worth $2¾ million for four 138 MW water turbine driven alternators for the Bersimis—Lac Casse project of the Quebec Hydro-Electric Commission. The second contract, worth more than $1 million, was for two 33 MW turbo-alternator sets for the Manitoba Hydro-Electric Board. The B.T.H. Co. secured their first entry in this market in the e.h.v. switchgear field with a contract for six 230 kV, 7,500 MVA oil circuit breakers for British Columbia. Referring to the Australian General Electric Co., jointly owned with the International General Electric Co., the chairman said that since the turn of the year they had acquired the International General Electric's shareholding. They had substantial manufacturing concerns in India and South Africa.

Viscount Chandos then dealt with the large programme of works expansion in various parts of the country and in Northern Ireland. In connection with the erection of atomic power stations they had joined forces with John Thompson, Ltd., boiler manufacturers, forming a team of scientists and engineers working in collaboration with the Atomic Energy Authority and the C.E.A. in the development of plant and techniques for the building and operation of these stations. To finance these schemes new ordinary shares were being issued, and Viscount Chandos gave particulars of the issue (reference to which was made in our last issue). The chairman concluded with references to the acquisition of Birlec, Ltd., and Siemens Brothers & Co., Ltd., some of the work carried out at the research laboratories and the need for an increasing supply of physicists, chemists, metallurgists, and professional mechanical and electrical engineers.

Allen West & Co., Ltd., report a group profit for the year ended 31st January last (subject to audit), after all charges (including taxation), of £426,081, as compared with £339,240 for the previous year. Taxation charged was £397,515 (after writing back £23,728 from previous years no longer required). The profit attributable to members of the Holding company amounts to £425,446 (against £338,600). General reserve receives £250,000 and it is proposed to pay a final dividend of 15 per cent on the increased ordinary stock of £1,750,000. This compares with 17½ per cent on the then issued capital of £1,170,000 in respect of the previous year.

North of Scotland Hydro-Electric Board.—The Treasury has approved a proposal by the Board to make a further issue of £8,465,662 of stock. The issue will be North of Scotland Electricity 3 Per Cent Guaranteed Stock, 1968-73; no market quotation is at present being sought. The stock is being guaranteed by the Treasury. The purpose is to reimburse the Central Electricity Authority in respect of the net amount of compensation stock which the Authority has issued on the Board's behalf. The Board has made previous issues of stock amounting to £107 million and the present issue will rank *pari passu* with these.

Ericsson Telephones, Ltd.—Presiding at the annual meeting held on 31st March, Sir Harold A. Wernher (chairman) said that invoiced sales in 1954 constituted a record. The sales were well spread, both at home and overseas. During the past few months the home demand had improved. Approximately 400,000 more telephones were connected by the British Post Office in the past year, leaving just under 400,000 applications outstanding. New applications were in the region of 400,000 a year. Research was always going on to improve or cheapen the service and they also carried out research work for Government Departments.

J. & F. Stone Lighting & Radio, Ltd., has declared an interim dividend of 10 per cent on the ordinary stock (unchanged).

New Companies

Phosco, Ltd. — Registered 28th February. Capital £20,000. Manufacturers and distributors of, agents for and wholesale and retail dealers in street lighting lanterns and all equipment for street and commercial lighting installations and electrical goods of all kinds, street lighting engineers, electrical engineers, pylon erectors, etc. Directors: C. A. Marques and C. R. Belling. Regd. office: 3, St. Helens Place, E.C.3.

Newport Instruments (Scientific & Mobile), Ltd.—Registered 21st February. Capital £100. Electronic and electrical manufacturers, wholesale merchants, fitters, factors, maintainers and designers and repairers of and dealers in electronic, electrical, medical, surgical and scientific apparatus, etc. Ian I. Boswell is the first director. Regd. office: 23, Union Street, Newport Pagnell, Bucks.

H. G. Barnett & Partners, Ltd.—Registered 24th February. Capital £5,000. Electrical engineers and contractors and general installation contractors, lighting specialists, radio and television engineers, etc. Directors: H. G. Barnett and Mrs. Marjorie H. Barnett. Secretary and solicitor: Vincent Collinson, 10, Talbot Road, Blackpool.

Yeldon & Gardiner, Ltd.—Registered 2nd March. Capital £10,000. To acquire the business of an electrical contractor carried on by E. R. Gardiner at 4, Reservoir View, Tavistock Road, Plymouth, as "Yeldon & Gardiner," etc. Directors: E. R. Gardiner, H. G. Baker, Linda M. Gardiner and Roma K. Baker.

Better Electrics Credit, Ltd.—Registered 2nd March. Capital £100. Hire-purchase financiers, etc. Directors: R. Nelson-Harris and C. Gee (directors of Better Electrics, Ltd.). Regd. office: 1451, London Road, Norbiton, S.W.16.

Potter's Electrical Repair Works, Ltd. — Registered 28th February. Capital £8,000. Electrical engineers, electrical manufacturers, repairers and suppliers of railway, tramway, electric, magnetic, galvanic and other apparatus and accessories, mechanical engineers, armature and coil winders, suppliers and repairers, etc. Directors: A. L. Potter, Mrs. Mary E. Potter and A. Potter Love. Regd. office: Delhi Street, Swansea.

Electronic Components, Ltd. — Registered 25th February. Capital £100. Electronic, radio and television engineers, electrical engineers and general electrical installation contractors, etc. Directors: H. G. Pitt and Mrs. Elizabeth Davies. Solicitors: Marchant Harries & Co., Aberdare.

H. C. Avery, Ltd.—Registered 28th February. Capital £100. Electrical engineers and contractors, electricians, radio engineers, etc. H. C. Avery is the first director. Regd. office: Thames Side, Kingston-on-Thames, Surrey.

Increases of Capital

Drayton Regulator & Instrument Co., Ltd.—Increased by £150,000, in 2s ordinary shares, beyond the registered capital of £150,000.

A. Anderson & Son (Electrical Engineers), Ltd. — Increased by £27,000, in £1 shares, beyond the registered capital of £3,000.

Bankruptcies

J. S. Anderson, trading as Electronic Services at Nearavon, Salisbury Street, Fordingbridge, Hants, radio and electrical engineer.—Trustee, Mr. A. H. Brown, The Square, Fordingbridge, released 16th February.

J. W. Luker and **H. A. R. Phillips,** lately carrying on business in partnership at East Street, Lewes, and at 206, High Street, Lewes, Sussex, under the style of Gordon & Luker, electrical contractors.—Last day for receiving proofs for dividend 9th April. Trustee, Mr. J. S. Bradley-Hole, 7, Old Steine, Brighton, 1.

J. W. Luker and **H. A. R. Phillips** (particulars as above). Separate estate of J. W. Luker.—Last day for receiving proofs for dividend 9th April. Trustee, Mr. J. S. Bradley-Hole, 7, Old Steine, Brighton, 1.

R. B. Goetze, residing at 5, North End, Wisbech, Cambs, lately carrying on business at the Old Market, Wisbech, as an electrical contractor.—First and final dividend of 2s 5d in the £, payable at 41, Sydney Street, Cambridge.

C. G. Carder, 2, Bone Hill, Buckingham, electrician. — Receiving order made 24th March on debtor's own petition.

A. C. Payne, 40, Springfield Road, Wickersley, Rotherham, Yorks, formerly carrying on business at that address as electrical contractor.—Last day for receiving proofs for dividend 15th April. Trustee, Mr. J. B. G. Moore, 55, Queen Street, Sheffield.

Liquidations

Electrical Accessories (Lancaster), Ltd. — Winding up voluntarily. Liquidator, Mr. R. P. Booth, 5, Rumford Place, Liverpool, 3, appointed 16th March.

Micox Electrical Equipment, Ltd.—Meeting on 28th April at 9, Ironmonger Lane, London, E.C.2, to receive an account of the winding up by the liquidator, Mr. D. A. Lumley.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 231, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Tuesday, 12th April

BELFAST.—Queen's University, 6.30 p.m. I.E.E. Northern Ireland Centre. "Equipment of Instrumental Accuracy for Recording and Reproduction of Electrical Signals Using Cinematograph Film," by H. McGregor Ross.

LONDON.—Connaught Rooms, W.C.2, 12.30 for 1 p.m. Electrical Industries Club. Luncheon followed by annual general meeting. Guest speaker, R. W. Moreton (British North Greenland Expedition).

MANCHESTER. — Engineers' Club, Albert Square, 7.15 p.m. Incorporated Plant Engineers, Manchester Branch. "Care and Maintenance of Internal Combustion and Light Diesel Engines," by F. N. Warmisham.

NEWPORT.—Flying Services Club, 28, High Street. Newport & District Electric Club. "The Automatic Telephone Exchange," by K. Gray.

Wednesday, 13th April

ABERDEEN.—Caledonian Hotel, 7.30 p.m. I.E.E. North Scotland Sub-Centre. "The Development of High-Voltage Cables," by J. S. Hastie.

BIRMINGHAM.—James Watt Institute, 6.45 p.m. I.E.E. South Midland Students' Section. "Modern Techniques in Solving Power Engineering Problems," by J. Banks.

Chamber of Commerce, New Street, 7.15 p.m. A.S.E.E. Birmingham Branch. "Photography."

BRADFORD.—Midland Hotel, 7.30 p.m. A.S.E.E. Bradford Branch. "Electrification of Ashfield Textile Mills," by A. Spencer.

GLASGOW. — Rowan's Coffee Room, Buchanan Street, 7.30 p.m. I.E.E. South-West Scotland Students' Section. Annual general meeting.

LONDON.—School of Hygiene & Tropical Medicine, Keppel Street, 6.30 p.m. British Institution of Radio Engineers, London Section. Discussion on "The B.B.C. V.H.F. F.M. Sound Broadcasting Service," opened by Dr. K. R. Sturley and F. T. Lett.

NEWCASTLE-UPON-TYNE. — Neville Hall, Westgate Road, 6 p.m. British Institution of Radio Engineers, North-Eastern Section. "The Manchester University Electronic Computor," by E. T. Warburton, followed by the annual general meeting.

PORTSMOUTH.—Chamber of Commerce, 46, Commercial Road, 6.30 p.m. I.E.E. Southern Centre. "Modern Developments in Atomic Energy," by Dr. T. E. Allibone, followed by annual general meeting.

WARRINGTON.—White Hart Hotel, 7.15 p.m. Institute of Industrial Supervisors, Warrington Section. "Industrial Lighting," by A. Wilcock.

YORK. — "Picture House Café," Coney Street, 7.15 p.m. A.S.E.E. York Branch. Films: United States Operations Mission.

Thursday, 14th April

DERBY.—Electricity Showrooms, Irongate, 7 p.m. Derby Electrical Society. Annual general meeting and film.

DUNDEE.—Queen's College, 7 p.m. I.E.E. North Scotland Sub-Centre. "Safety in the Use of Portable and Transportable Electrical Equipment in Industry," by J. W. Bunting.

GLASGOW.—39, Elmbank Crescent, 7 p.m. British Institution of Radio Engineers, Scottish Section. Film evening and exhibition of electronic apparatus.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Utilization Section. "The Installation of Metal-Sheathed Cables on Spaced Supports," by W. Holttum.

MANCHESTER.—N.W.E.B., Town Hall, 6 p.m. I.E.S. Manchester Centre. "Television Studio Lighting," by D. C. Lightbody.

Friday, 15th April

LONDON. — Dorchester Hotel. Scientific Instrument Manufacturers' Association. Annual dinner-dance.

NEWCASTLE-UPON-TYNE. — County Hotel. Institution of Heating and Ventilating Engineers, North East Coast Branch. Smoking concert.

Iron and Steel Institute

The annual general meeting of the Iron and Steel Institute will be held on 27th and 28th April at 4, Grosvenor Gardens, London, S.W.1.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s 8d each including postage) will be obtainable after 11th May from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1950

7644. British Communications Corporation, Ltd., and Heftman, T. S.—Automatic gain control circuits. 27th June, 1951. (729732.)

8205. Electric & Musical Industries, Ltd. —Television film scanners. 2nd April, 1951. (729541.)

23061. Sperry Corporation.—High frequency electron discharge tubes. 20th September, 1950. (729812.)

26257. Sinclair, S.—Remote registering and/or control systems for use with gas-filled or so-called pressurized power and telecommunication cables. 24th January, 1952. (729813.)

1951

3724. Soc. d'Etudes, de Recherches et d'Applications des Poudres Agglomérées, and Teszner, S.—Multi-electrode granular semiconductive bodies. 15th February, 1951. (729542.)

4301 and 4385. National Research Development Corporation.—Multi-electrode gaseous-discharge tube circuits. 22nd February, 1952. (729637/8.) 7044. Corona-discharge tubes. 27th March, 1952. (729814.)

8044. General Electric Co., Ltd., and Gallizia, E.—Vapour electric arc convertors. 7th April, 1952. (729737.)

8444. Henley's Telegraph Works Co., Ltd., W. T., and Griffiths, F. T.—Delivery of filamentary material such as cables. 10th April, 1952. (729738.)

9786. British Thomson-Houston Co., Ltd.—Magnetron amplifiers. 26th April, 1951. (729543.)

16569. General Electric Co., Ltd.—Electric circuit arrangements for electric locomotives. 14th July, 1952. (729816.)

18118. Vredenburg-Inglesby, J. C., and Fries, G.—Method and apparatus for optically projecting electron images. 29th July, 1952. (729546.)

23631. General Electric Co., Ltd., Davis, G. E., and Irving, H. D.—Apparatus for detecting the presence or absence of a conducting or magnetic object. 10th April, 1953. (729817.)

27055. English Electric Co., Ltd.—Welding thermo-plastic materials. 13th February, 1953. (729742.)

27597. Electric & Musical Industries, Ltd. —Magnetic deflecting means for cathode-ray tubes. 16th October, 1952. (729918.)

29623. Siemens Electric Lamps & Supplies, Ltd.—Emissive cathodes. 4th December, 1952. (729819.)

30489. British Telecommunications Research, Ltd.—Electrical storage devices for coded electrical signals. 19th December, 1952. (729743.)

1952

1732. Foster Transformers, Ltd., formerly Foster Transformers & Switchgear, Ltd., and Jennings, R. E.—Electric arc welding systems. 16th January, 1953. (729745.) 2751. Electric arc welding systems and apparatus. 28th January, 1953. (729747.)

3963. British Thomson-Houston Co., Ltd. —Tungsten cathodes. 6th January, 1953. (729921.)

6851. Brennan, J. B.—Electrodes for electrolytic devices. 17th March, 1952. (729822.)

7145. Powers-Samas Accounting Machines, Ltd.—Electrical counter circuits. 11th February, 1953. (729751.)

7923. International Patents Trust, Ltd.— Electrostatic transducers. 27th March, 1952. (729556.)

9715. Metropolitan-Vickers Electrical Co., Ltd.—Apparatus for actuating control devices in a predetermined sequence. 16th April, 1953. (729753.)

10375. Marconi's Wireless Telegraph Co., Ltd.—Radar display systems. 9th March, 1953. (729923.)

11434. McCarthy, P. M.—Electric ceiling roses. 6th May, 1953. (729559.)

13245. Rotax, Ltd.—Voltage regulators for electric current generators. 2nd July, 1953. (729925.)

14950. Smith & Sons (England), Ltd., S. —Devices driven by springs adapted to be intermittently wound by electromagnetic means. 15th June, 1953. (729926.)

16426. Telefonaktiebolaget L. M. Ericsson.—Electron discharge devices. 30th June, 1952. (729930.)

18077. Cinema-Television, Ltd.—Electrical timing arrangements. 15th July, 1953. (729931.)

19515. Standard Telephones & Cables, Ltd.—Electron velocity modulation tubes. 1st August, 1952. (729766.)

20492. Metropolitan-Vickers Electrical Co., Ltd.—Electrostatic separation. 4th August, 1953. (729934.)

21561. British Telecommunications Research, Ltd.—Feedback amplifiers. 6th August, 1953. (729827.)

22200. Jackson, J.—Reference electrode units. 3rd December, 1953. (729575.)

23995. Metropolitan-Vickers Electrical Co., Ltd.—Devices for detecting the presence of magnetic material. 20th August, 1953. (729829.)

25440. Standard Telephones & Cables, Ltd. — Filamentary cathode supporting arrangements in electron-discharge devices. 10th October, 1952. (729577.)

25613. Bendix Aviation Corporation.— Electrical actuators. 13th October, 1952. (729775.)

28060. Standard Telephones & Cables, Ltd.—Electrical insulating material and method of making same. 7th November, 1952. (729669.)

29024. Siemens & Halske Akt.-Ges.— Terminal circuit arrangements for signal circuits. 17th November, 1952. (729945.)

29115. British Thomson-Houston Co., Ltd.—Magnetrons. 28th October, 1953. (729583.)

30605. Telefunken Ges. für Drahtlose Telegraphie. — Additive mixing circuits for frequency changing such as are employed in superheterodyne radio receivers. 3rd December, 1952. (729950.)

31833. Automatic Telephone & Electric Co., Ltd.—Electric signalling systems. 5th November, 1953. (729786.)

31840. Westinghouse Electric International Co.—Voltage reference networks. 16th December, 1952. (729589.)

31995. International Aeradio, Ltd., Gallagher, P., Turner, H., and Peat, J. D.— Radio communication systems. 17th December, 1953. (729957.)

31998. General Electric Co.—Automatic control mechanism for defrosting refrigerator evaporators. 17th December, 1952. (729958.)

1953

49. Philips Electrical Industries, Ltd.— Magnetic electron lenses. 1st January, 1953. (729840.)

500. Licentia Patent-Verwaltungs-Ges.— Devices for an electrostatic application of liquid coating materials. 7th January, 1953. (729842.)

718. Standard Telephones & Cables, Ltd. —Electromagnetic wave generator. 9th January, 1953. (729676.)

923. Lodge-Cottrell, Ltd.—Apparatus for the electrical precipitation of suspended particles from gaseous fluids. 11th January, 1954. (729592.)

1040. M-O Valve Co., Ltd., Booth, A. J., and Cook, K. G.—Systems for controlling the pressure of a gas in an enclosure. 12th January, 1954. (729962.)

2932. Foster Wheeler, Ltd.—Heat-exchanger. 2nd February, 1953. (729793.)

4821. General Electric Co.—Electron tubes. 20th February, 1953. (729682.)

5932. Telefonaktiebolaget L. M. Ericsson. —Crystal diodes. 3rd March, 1953. (729850.)

7823. Standard Telephones & Cables, Ltd.—Electron-discharge devices. 20th March, 1953. (729611.)

9394. Philips Electrical Industries, Ltd.— Colour television image reproducing apparatus. 7th April, 1953. (729685.)

9981. Westinghouse Brake & Signal Co., Ltd., Walker, A. H. B., and King, K. G.— Voltage regulating systems. 9th February, 1954. (729972.)

12990. Electric & Musical Industries, Ltd.—Circuits for levelling datum signals interspersed in electric signals, for example television signals. 2nd April, 1951. (729621.)

15242. Hoover, Ltd.—Suction cleaners. 1st June, 1953. (729807.)

17021. General Electric Co.—Starting and shutdown systems for the gas turbine prime-movers of electrically propelled locomotives. 19th June, 1953. (729693.)

17850. British Insulated Callender's Cables, Ltd.—Electric cables and their manufacture. 25th June, 1954. (729695.)

18453. Westinghouse Electric International Co.—Fluorescent screens and methods of forming such screens. 3rd July, 1953. (729867.)

18679. Philips Electrical Industries, Ltd. —Electro-mechanical vibrators comprising magnetostrictive members. 6th July, 1953. Addition to 718114. (729868.)

19211. General Electric Co.—Clothes wringers. 10th July, 1953. (729698.)

20144. Associated Technical Manufacturers, Ltd.—Screened electric cables. 14th September, 1953. (729700.)

21629. General Electric Co.—Mass spectrometer apparatus. 5th August, 1953. (729877.)

22432. Babcock & Wilcox, Ltd.—Manufacture of tubular heat exchangers. 14th August, 1953. (729989.)

22710. Telefunken Ges. für Drahtlose Telegraphie.—Electromagnetic metal detecting instruments. 18th August, 1953. (729706.)

23436. Foster Wheeler, Ltd.—Vapour generators. 25th August, 1953. (729990.)

23468. National Research Development Corporation.—Electrical slicer circuits. 25th August, 1953. (729882.)

24279. Daimler-Benz Akt.-Ges.—Electrical means for detecting and measuring untrue running or radial movement of a rotatable machine part. 2nd September, 1953. (729884.)

24421. Moulon, J. M.—Two-stage transistor amplifiers. 3rd September, 1953. (729711.)

27430. British Thomson-Houston Co., Ltd.—High voltage insulating bushings. 27th August, 1954. (729995.)

30803. General Electric Co.—D.c. amplifiers employing junction transistors. 6th November, 1953. (729895.)

31206. Westinghouse Electric International Co.—A.c. motor control systems. 11th November, 1953. (729996.)

31526. Philips Electrical Industries, Ltd. —Radar systems. 13th November, 1953. (729897.)

33811. Small Electric Motors, Ltd.— Balancing machines. 4th December, 1953. (729901.)

34877. Wingfoot Corporation.—Electronic thickness gauge. 15th December, 1953. (729727.)

GENERATION AND DEVELOPMENT

Power Station Contracts

Contracts have been placed by the Central Electricity Authority during the past month for power stations, transforming stations and transmission lines, amounting in the aggregate to £6,208,690. They include the following:—

Portishead "B" power station, near Bristol. Ash and dust handling plant.—John Thompson Industrial Constructions.

East Yelland power station, near Barnstaple. Reinforced concrete chimney.—Tileman & Co.

Lincoln power station. Foundations to power station and ancillary buildings' extensions.—Wm. Moss & Sons.

Nottingham power station. Superstructure for extensions.—Taylor Woodrow Construction Co.

Rogerstone power station, Mon. Two 550,000 lb/hr boilers.—Babcock & Wilcox.

Blyth "A" power station, Northumberland. One 120,000 kW turbo-generator, condensing and feed heating plant.—Metropolitan-Vickers Electrical Co. Two 120 MVA, 275/66 kV interconnector transformers.—C. A. Parsons & Co. 66 kV, 2,500 MVA indoor switchgear and 275 kV isolators and connections.—A. Reyrolle & Co.

Stella North power station, near Newcastle upon Tyne. Ash quay, settling ponds, transfer, make-up and circulating water pumphouses. — Sir Robert McAlpine & Sons (Newcastle upon Tyne).

Stella South power station. Circulating water pumphouse foundations and superstructure, ash quay, settling ponds and transfer pumphouse.—Sir Robert McAlpine & Sons (Newcastle upon Tyne).

Barony power station, Ayr. Two cooling towers, circulating water pumphouse and ancillary works.—Bierrum & Partners.

South Denes, Great Yarmouth. 33 kV, 1,000 MVA and 6·6 kV, 350 MVA switchgear. —English Electric Co.

Eastern Board's £9 Million Programme

The Eastern Electricity Board's programme for extending and improving the system throughout its Area in the financial year just begun will involve capital expenditure of £9 million. This development will mean the installation of more than 1,000 miles of new mains and an additional transformer capacity of about 500,000 kVA. A sum of £1 million is included for rural developments during next year and this will bring electricity to 12,000 more rural premises including 1,400 farms. Since 1948 the Board has devoted over £41 million to developing the system by extension and reinforcement and connected over 350,000 new consumers, including 8,200 farms.

The Board's second five year programme of rural development will be completed in 1958 and by that time the Board will have brought electricity to 110,000 rural premises (including almost 12,000 farms) which were without electricity at the time of nationalization. Some 22,000 farms in the Eastern Area will then have a supply of electricity.

L.E.B. Reorganization

From Friday, 1st April, the North Western Sub-Area organization of the London Electricity Board has been disbanded and replaced by two managed Districts as follows:—St. Marylebone/St. Pancras District under the management of Mr. J. J. Lesser with offices at 38, Aybrook Street, St. Marylebone, London, W.1; and Hampstead/Willesden District under the management of Mr. B. L. Wells, B.Sc.(Eng.), M.I.E.E., with offices at Lithos Road, Hampstead, London, N.W.3.

S. Wales Domestic Tariff Revision

The South Wales Electricity Board has announced two changes in its domestic tariff. The first amendment provides for the exclusion of rooms in excess of ten from assessment, so that consumers living in very large houses will receive a small reduction in charge (formerly an assessment of 5 kWh at 5d was made for each room in excess of ten). Some difficulty has been experienced in the assessment of sculleries and the Board has decided, in effect, to treat the kitchen/scullery in any house as one room for the purpose of the tariff. A scullery containing no cooking apparatus will as hitherto be exempt from assessment and one with cooking apparatus will now also be excluded where there is a second room containing cooking apparatus capable of meeting the normal needs of the household.

Standard Farm Tariffs

New standard tariffs, which will replace all existing tariffs at present in force for farm supplies to farm consumers, are announced by the North Western Electricity Board.

The new tariffs have been designed to obtain as nearly as possible the same revenue from farm usage of electricity as would have been obtained from the tariffs now in force. They will lead to economies in administration through the reduction in the number of meters to be read and the simplification of billing, and as consumers will be charged through one meter this will enable new consumers and those rewiring their premises to have simpler and more economical wiring installations.

Farm consumers will have the option of choosing between two tariffs. The first consists of a flat rate of 5d/kWh for all consumption in the premises comprising the farm and farm house and the second, which it is expected will be chosen by the majority of consumers, is a combination of the standard domestic tariff for the farm house consumption and a two-part tariff for the farm usage comprising a graded quarterly fixed charge and a running charge of $\frac{7}{8}$d/kWh.

The quarterly fixed charge is related to the "assessed demand" of the electrical equipment on the farm in accordance with the following scale:—Not exceeding 3 kW, £1 10s; 3-6 kW, £2 5s; 6-12 kW, £3 10s; 12-25 kW, £5 10s; and exceeding 25 kW, £8. The "assessed demand" excludes domestic load and means the aggregate load calculated as follows:—Sterilizers and water heaters not exceeding 9 kW loading each, per kW, 0·75 kW; motors, per h.p., 0·5 kW; and lighting and other apparatus, per kW, 1 kW. The assessed demand of crop drying or other load which is not used between the hours of 7 a.m. and 6 p.m. during the months of November, December, January and February, will be calculated at one-third of the rates otherwise applicable.

For existing consumers the new tariffs will apply in respect of electricity consumed after the first normal meter reading following 30th June next. The combined supplies to the farm and farm house will be metered through one meter, and all additional meters at present installed will be removed.

Transfer of Supply Network

As from 1st April the electricity supply to Aylesham, the Kent mining village, has been transferred from the National Coal Board to the South Eastern Electricity Board. At a meeting of the Eastry Rural District Council it was stated that the transfer would result in a reduction in the charge for lighting and that improvements in street lighting would be possible.

Assam Project

India is to be helped by Canada in the construction of the Rs15 million (£1,125,000) Umtru hydro-electric project in Assam. Letters which form the basis of an agreement providing for joint Indo-Canadian participation were exchanged recently between the Finance Minister of the Government of India, Mr. C. Deshmukh, and Mr. Escott Reid, Canadian High Commissioner in India. Under the agreement, Canada will contribute engineering services and electrical equipment for the project at an estimated cost of about Rs5 million (£375,000). The Canadian Government has also agreed to cover expenditure up to about Rs10 million (£750,000) from the rupees which become available from the sale of Canadian industrial raw materials provided to India under the auspices of the Colombo Plan.

Indian Power Production

By the end of 1953 the public supply undertakings in India had an aggregate installed capacity of 2,305 MW as compared with 2,061 MW in 1952, according to the annual report of the Central Water and Power Commission. Of the total, roughly 60 per cent consisted of steam plant, 32 per cent

of hydro and the rest of diesel plant. The increase over the previous year was 11·8 per cent and was mainly due to the commissioning of the Bokaro power station of the Damodar Valley (three sets of 50 MW), Chandni (thermal) with three sets of 15 MW and Moyar (hydro) with one set of 12 MW. The production during the year amounted to 6,697 million kWh, an increase of 575 million over the previous year.

The *per capita* consumption for the whole country was only 15 kWh, although if industrial establishments and railways are taken into account the average consumption figure was 24 kWh. The total capital expenditure to date on all the public supply undertakings is estimated at £145 million.

The country's power production has been rising steadily since 1949 and from statistics available for the first nine months of 1954 it appears that the figure for that year will be in the region of 7,200 million kWh. It is also expected that by 1956, when most of the present hydro projects will be approaching completion, the installed capacity will have reached 2,500 MW.

Diesel Power in Zanzibar

THE new Saateni generating station, which was opened recently by the Sultan of Zanzibar, H.H. Seyyid Sir Klalifa bin Harub, G.C.M.G., C.B.E., marks a turning point in the development of electric power generation on the island. The station, which is situated a mile and a half from the ancient Arab quarter of Stone Town, is equipped with three 750 kW diesel generating sets. These will provide the island with its first a.c. supply, superseding the existing d.c. network, which has been in use for thirty years or more. A fourth set is now being added and this will bring the installed capacity of the station up to 3,000 kW.

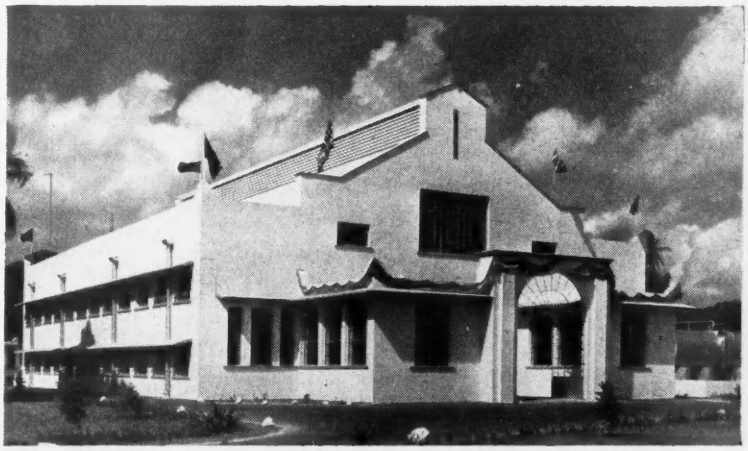
The new scheme not only embraces the construction of the power station and generating equipment, but includes the installation of a new ring main, with ten substations. Buildings directly connected to this ring main system include the Sultan's Palace, which has already been provided with power, and the Zanzibar Hospital. Of the ten substations installed, four are at Stone Town, two at Saateni, in the vicinity of the power station, and one each at Mlandee, Holmwood, Kiliman and the hospital.

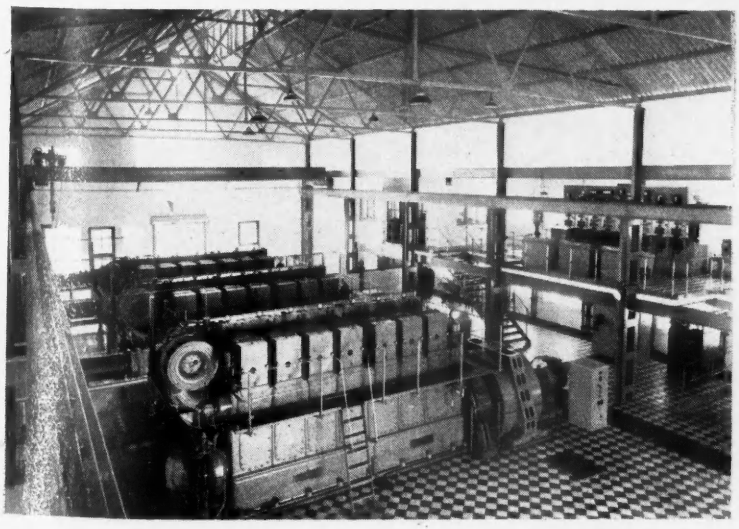
The equipment for the new station was manufactured by the English Electric Co., Ltd., at its Liverpool, Rugby and Stafford Works, to the order of the Crown Agents for Overseas Governments and Administration and the consulting engineers were Preece, Cardew & Rider. The underground cables were manufactured and laid by Enfield Cables, Ltd.

The three engines installed in the station are 7-cylinder type SRL units, each having a bore and stroke of 15in and 20in respectively. Each engine is coupled to a standard English Electric type GL alternator, of the single pedestal bearing type, which gives an output of 937 kVA at 0·8 power factor, generating at 11 kV, three-phase, 50 c/s and running at 375 r.p.m. All three machines are arranged to run in parallel.

In the event of an emergency power supply being required for the power station services, a 29 kW diesel alternator set, driven by a Perkins 6-cylinder diesel engine, can be brought into operation. The set is mounted on a common fabricated baseplate and is arranged for electric starting.

The main station switchboard consists of an 8-panel type OLX board, including three 1,000 kVA incoming generator units, two 250 kVA station transformer units, two 2,000 kVA feeder units, and one bus section switch. A synchronizing panel of the swing bracket type is incorporated.





Saateni power station, Zanzibar, and (left) interior view of the station

The Saateni power station building, which blends admirably with the local architecture, was designed by Major E. A. T. Dutton, the former chief secretary of the Public Works Department, while the original design of the generation and distribution scheme was in the hands of Mr. P. F. Collier, the electrical and mechanical engineer, P.W.D.

Present power requirements are such that one generating set with an output of 750 kW is sufficient to supply the a.c. demand. However, it is anticipated that a further two sets will be needed in the next two or three years.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Alnwick.—16th April. R.D.C. Electrical installations in 15 houses at Longhoughton. Reavell & Cahill, architects, Lloyds Bank Chambers.

Belfast.—19th May. Corporation Electricity Department. Chlorinating plant for Belfast West power station. (See this issue.)

Birmingham.—15th April. City Welfare Committee. Installation of electric lift at the Aged Persons' Home, Alvechurch Road, West Heath. Sir Herbert J. Manzoni, city engineer, Civic Centre, 1.

Bridgwater.—18th April. Town Council. Additional points and power plugs in approximately 800 Council houses. Borough architect.

Canada.—25th April. Manitoba Hydro-Electric Board, Winnipeg. Eight boiler feed pumps and 2,300 V motors. (E.S.B. 6414/55. Ten/13155.)*

Durham.—C.C. Electrical installation at the Shire Hall. G. R. Clayton, county architect, Court Lane.

Egypt.—5th May. Egyptian State Broadcasting Administration. 2 kW medium wave broadcast transmitter. (E.S.B. 6593/55. Ten/13207.)*

India.—20th April. Director General of Supplies and Disposals. Five beacon transmitters. (E.S.B. 6757/55. Ten/13221.)*

25th April. Government of Madras Electricity Department. H.v. and l.v. cables and cable boxes. (E.S.B. 6754/55. Ten/13162.)*

Iraq.—7th May. Ministry of Development, Bagdad. Two diesel-electric power plants, each plant comprising a number of 800-1,000 kW generating sets. (E.S.B. 6867/55. Ten/13193.)*

Korea.—31st August. U.S. Foreign Operations Administration. Manufacturing machinery and equipment including induction motors, 200 kW, 3,300 V diesel generating set, switchboard, switchbox, three 200 kVA and one 40 kVA transformers and oil circuit breakers, etc. (E.S.B. 6296/55. Ten/13144.)*

Kuwait.—26th April. Government Department of Electricity. Twelve 750 kVA, 11 kV/433 V power transformers. (E.S.B. 6980/55. Ten/13228.)*

New Zealand.—11th May. Stores Division, General Post Office. P.v.c. insulated and flameproof enamelled wire. (E.S.B. 7087/55. Ten/13229.)*

Penrith.—Cumberland and Westmorland Joint Agricultural Education Committee. Electric wiring and equipment for Sewborwens Farm, Newton Rigg. J. H. Haughan, Cumberland county architect, Portland Square, Carlisle.

Portuguese East Africa.—30th April. Permanent Purchasing Commission, Lourenço Marques. Electrical equipment for the Public Works Department Research Laboratory. (E.S.B. 6550/55. Ten/13150.)*

South Africa.—21st April. Union Tender and Supplies Board. Electric wire and cable. (E.S.B. 6861/55. Ten/13178.)* Radio components. (E.S.B. 6863/55. Ten/13177.)*

28th April. Stores Department, South African Railways. Switchgear and transformers. (E.S.B. 6799/55. Ten/13168.)* Armature rewinding wire. (E.S.B. 6791/55. Ten/13169.)*

Syria.—2nd June. Service de l'Electricité et de l'Eau, Municipality of Lattakia. Two generating sets. (E.S.B. 6644/55. Ten/13158.)*

Uruguay.—25th April. Ministerio de Salud Publica. Electric cables, insulators, insulating tape, stoves, irons, fans and lamps. (E.S.B. 6907/55. Ten/13196.)*

27th April. Administracion de Ferro-carriles del Estado, Uruguayan Government. Telephone cables and leads. (E.S.B. 6904/55. Ten/13200.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Bangor.—Technical college; Williams & Williams, Ltd., Cae Mur, Caernarvon.

Barnstaple.—X-ray department for North Devon Infirmary; South Western Regional Hospital Board, Tyndalls Park, Bristol.

Basildon.—Kingswood County Primary School; Poulton & Freeman, architects, 6a, Wyndham Place, London, W.1.

Billingham-on-Tees.—Apprentices' school (£100,000); Imperial Chemical Industries, Ltd.

Birmingham.—Houses (68), Shenley Farm estate; C. B. Parkes, architect, Bournville Estate Offices, Kings Norton.

Bradford.—Baths, Harrogate Road/Green Lane site; W. H. Leathem, town clerk.

Brighton.—Flats (34) on the Somerset Street/Upper Bedford Street site; borough engineer and surveyor, 26-30, King's Road.

Bromsgrove.—Dwellings (96), Charford estate, for U.D.C.; C. Bryant & Sons, Birmingham.

Chadderton.—Bungalows (80), Broadway site; U.D.C. surveyor.

Chelmsford.—Two-storey furniture showrooms at 44/45, High Street; Brown Bros. & Taylor, Ltd., furnishers, 76, Brook Street, London, W.1.

Chichester.—Houses (65), Parklands estate; R. A. J. Cork, city engineer, North Street.

Dartford.—Houses (66), in three blocks, on the Temple Hill Neighbourhood Unit; T. Armstrong, town clerk.

Dover.—Swimming baths at Woolcomber Street corner site (£60,000); borough surveyor, Brook House.

Edmonton.—Factory extensions (£25,000); Century Glass Works, Ltd., Angel Factory Colony, London, N.18.

Felling-on-Tyne.—Houses (3,500); U.D.C. housing architect.

Gateshead.—Factory, Park Road, for Jackson The Tailor, Ltd., Clayton Street, Newcastle-on-Tyne.

Extensions to factory, Team Valley estate; A. K. Smiths Delivery Vehicles, Ltd.

Hastings.—Multi-storey block of 188 flats, with laundry, etc., Woodland Vale Road; K. F. Wray, architect, 43, Wellington Square.

Hatfield.—Houses (72), Redhall Farm site, for R.D.C.; J. H. Parker, architect, 82, Great North Road.

Hebburn.—Shops, flats and 100 houses, Campbell Park and Monkton Lane No. 2 housing estates; R. C. Bestow, U.D.C. surveyor.

Hendon.—Hotel, Great North Way and Hendon Lane (£75,000); Dodds & White, architects, 45, Queen Anne Street, London, W.1.

Hove.—Flats (86) on the Cromwell Road/The Drive corner site; T. R. Humble, borough surveyor.

Jarrow.—Blocks of dwellings (£896,000); borough engineer.

King's Lynn.—Two secondary modern schools at Queensway (£190,000) for Norfolk E.C.; chief education officer, Stracey Road, Norwich.

Liverpool.—Showrooms and offices, Castle Street and Lord Street; Pearl Assurance Co., Ltd., High Holborn, London, W.C.1.

London.—Works and offices, Blackfriars Road, Southwark; Heidelberg Printing Co., Ltd., Eyot Works, St. Peters Square, W.6.

Government offices, Whitehall; E. Vincent Harris, architect, 19, West Eaton Place, S.W.1.

Malvern.—C.E. Special Agreement School; Yorke, Rosenberg & Mardall, architects, 2, Hyde Park Place, London, W.2.

Manchester.—Factory and offices at Irlam Street for James Moores, Ltd.; F. V. Newsome, architect, 26, Derby Road, Heaton Moor, Stockport.

Synagogue at Middleton Road, Crumpsall, for Heaton Park Hebrew Congregation; Peter Cummings, architect, 16, Oxford Street.

Middlesbrough.—Church and presbytery, Chantry Close; T. A. Crawford, architect, 80, Borough Road.

Newcastle-on-Tyne.—Radiological wing at the General Hospital; P. H. Knighton, chief architect, Newcastle Hospital Board, Dunira, Osborne Road.

Northumberland.—Five secondary modern schools at Ponteland, Morpeth, North Sunderland, Alnwick and Tweedmouth for the C.C.; C. C. Brown, county architect, County Hall, Newcastle-on-Tyne.

Peterborough.—Houses (118), Tennyson Road and Walton Road; city surveyor.

Crematorium, City Cemetery; John P. Chaplin, architect, 4, Cathedral Close, Norwich.

Redditch.—Factory, Studley Road; Lewis Spring Co., Ltd., Resilient Works, Queen Street.

Richmond (Surrey).—Shops and offices on site adjoining Town Hall (£53,300); borough surveyor.

Staffs.—Secondary mixed grammar school at Bromley Lane, Brierley Hill, first section of county primary junior and infants' school at Wall Heath, secondary school in Bromley Lane, Kingswinford, and secondary school at Hawes Hill; County Education Offices, Green Hall, Lichfield Road, Stafford.

Stalybridge.—Houses (74), Copley estate; borough engineer.

Twickenham.—Dwellings (56), Uxbridge Road; borough engineer.

Walsall.—Factory, Green Lane; W. A. Lonsdale & Son, general merchants, Regent Street.

Walthamstow.—Showrooms, offices, flats and maisonnettes, High Street; borough architect.

Washington.—Houses (78), Coach Road estate; U.D.C. surveyor.

West Hartlepool.—Houses, Farndale Road, Seaton Carew; A. G. Sinclair, borough architect.

Workington.—Houses (120), Moorclose Valley estate; borough surveyor.

Proposed shops and offices at Murray Road, Timothy White & Taylors; L. G. Booth, staff architect, Burley Hill, Leeds, 4.

Worsley.—Proposed shops at the Hill Top estate; U.D.C. surveyor.

Yorks (East Riding).—County secondary schools at Driffield (£170,000), and Pocklington (£55,000), and further section of county secondary school at Hornsea (£50,000); county architect, County Hall, Beverley.

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